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NOVEMBER 1980 **NUMBER 147**

Monthly Report on the Uranium Market

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 147

The **Exchange Value** decreased again this month to $28.00 per pound U_3O_8, from $28.50 last month. Spot and near term inquiries to sell increased to a total of 7.1 million pounds U_3O_8 equivalent, up from 1.7 million pounds last month. The inquiries come from producers and both utility and non-utility inventory holders. Inquiries to purchase in the same time frame total 1.1 million pounds. Thus pressure on the market continues to be generally downward.

Five Transactions closed this month. One was a long term sale by an Australian seller to a European buyer. The other four were for near term delivery, involving a total quantity of about 1.6 million pounds U_3O_8 equivalent. The **Transaction Value** decreased to $29.00 per pound U_3O_8, down from $30.60 last month.

Nuexco has again recomputed **Apparent Future Consumption** of uranium through 1990, and the results are published in this Report. The current estimate is based on some refinements in the computational methods used. Also, new groundrules were used in estimating additions to installed nuclear capacity. Estimated consumption in the US from 1980 through 1990 decreased by about 90 million pounds U_3O_8 or 21 percent from the previous estimate (Nuexco Report 144). The major reason for the decrease is lower estimated installed nuclear capacity. During the same time period, estimated consumption decreased in the balance of the free world by a cumulative total of about 125 million pounds U_3O_8 through 1990, a 19 percent decrease from the previous estimate.

A new **Supply/Demand Balance** computation also appears in this Report. Due to lower estimated consumption, worldwide commercial uranium inventory levels are forecast to increase from about 250 million pounds U_3O_8 at the start of 1980 to almost 600 million pounds in 1990. Relative inventory levels on a worldwide basis are forecast to remain at about six times annual consumption during the entire decade of the 1980's.

The month's *Topical Essay* discusses the influence that inventory sellers have had on the uranium market in 1980. Included is a tabulation of transactions reported by Nuexco this year; buyers and sellers are classified according to whether they are uranium producers or non-producers.

The *Raw Materials* section describes in detail the Ranger project in Australia.

This Executive Summary may be reproduced for internal distribution.

11/80

NUEXCO

MONTHLY REPORT ON THE URANIUM MARKET

November 1980 No. 147

JAMES E. VAUGHAN, *EDITOR*

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URANIUM MARKET

GENERAL

Forecast of Apparent Future Consumption

This Report presents Nuexco's latest forecast of Apparent Future Consumption of U_3O_8. This forecast is substantially different from the previous one, both in the amount of consumption forecast and in the methodology used. Table 1 contains Nuexco's forecast of Apparent Future Consumption as of October 31, 1980. (The term consumption as used by Nuexco refers to U_3O_8 entering the pipeline for fabrication into nuclear fuel). The corresponding installed nuclear electric generating capacities are shown in Table 2.

The levels of consumption presented herein are significantly below the levels presented in Nuexco Report 144, (August, 1980). The most significant reduction in absolute terms is in the US. The changes are detailed in Table 3. Table 3 indicates a relatively minor annual difference in consumption as between Report 144 and Report 147 for US reactors currently operational. The big differences are in the category of US reactors under construction. The reasons for these differences are discussed below.

With this Report, Nuexco has introduced some refinements into the method used for forecasting Apparent Future Consumption.

1. *Tails assay* is assumed to be 0.25 percent U_{235}. It was 0.20 percent in past estimates. This change increases estimated consumption by approximately nine percent. This higher tails assay is consistent with practice at enrichment facilities outside the US. It is also consistent with the fact that the optimum tails assay is rising rapidly. The optimum tails assay is now about 0.254 percent U_{235} based on current Exchange Value and the current USDOE AFC prices for separative work.

2. *Capacity factor* for each reactor is forecast according to elapsed time since that reactor's date of commercial operation. Former Nuexco practice was to estimate a capacity factor for each reactor over that reactor's lifetime. The present method is based upon the application of historical capacity factor data to a power curve of the form,

$$y = a\,x^{b}$$

where:

y = annual capacity factor in percent and
x = years since date of commercial operations.

By applying a simple regression analysis to currently available data, the constants *a* and *b* can be determined.

It is a commonly held belief that capacity factor varies with reactor size. In fact, Nuexco's analysis has indicated that the same simple power curve regression fit is accurate, well within the limits of the analysis, for all US light water reactors of 150 MWe to 1,250 MWe. The same holds true, to a lesser extent, for non-US reactors. For ages of more than 20 years, Nuexco uses a constantly declining capacity factor. Nuexco uses different power curves for different types of reactors and for different regions. The effect of introducing this method of predicting capacity factor is to reduce consumption by a world-wide average of approximately 10 percent.

3. *Reactor physics* improvements are incorporated into the present Nuexco forecast. The two principal motivating forces are:

a. Competition among fuel fabricators, particularly in the market for PWR reload fuel. This has lead to more efficient fuel designs being proposed by the fabricators.

b. The trend toward refueling cycles of eighteen months or longer.

Each of these forces acts to increase the energy content in a given fuel rod. The effect is to reduce the uranium weight in the fuel rod or to increase the average fuel exposure or both. Of course, these changes lead to increases in average levels of enrichment and in the average expected capacity factor. Thus, essentially all important variables in the uranium consumption calculation for reload fuel (and initial core fuel to a lesser extent) will change. These changes in fuel design variables apply to essentially all plants which entered commercial operation after January 1969. Table 4 shows the increases in full exposure incorporated into Nuexco forecasts for PWRs, BWRs and heavy water reactors (HWRs). More efficient fuel design is expected to lead to an overall reduction in uranium consumption of approximately 15 percent between 1981 and 1985 and another 15 percent between 1985 and 1990.

Reduced forecasts of installed nuclear electric generating capacity account for the rest of the changes in Apparent Future Consumption between Report 144 and this Report. This is particularly true of the US. Table 5 is a comparison of installed nuclear capacity forecasts for the year 1990 between Nuexco Report 144 and Report 147. The net effect is a

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Table 1

APPARENT FUTURE CONSUMPTION[1]

(millions of pounds U_3O_8)

BUYER GROUP	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
United States											
Reactors now Operational	16.0	16.3	16.6	17.0	17.2	17.3	17.3	17.2	17.1	17.0	16.8
Now under Construction	0.7	4.6	6.3	10.4	13.2	15.5	18.2	17.9	20.5	23.1	23.5
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
US Subtotal	16.76	20.9	22.9	27.4	30.4	32.8	35.5	35.1	37.6	40.1	40.3
Europe											
Reactors now Operational	12.8	13.4	13.9	14.3	14.6	14.7	14.6	14.5	13.9	13.0	12.5
Now under Construction	4.4	12.2	15.0	21.1	16.2	19.4	20.2	21.7	20.1	20.6	21.5
Now on Order	-0-	-0-	-0-	-0-	-0-	2.2	3.2	8.7	8.1	9.7	8.7
Europe Subtotal	17.2	25.6	28.9	35.4	30.8	36.3	38.0	44.9	42.1	43.3	42.7
Far East[2]											
Reactors now Operational	3.6	3.5	3.4	3.3	3.3	3.2	3.1	3.0	2.9	2.8	2.8
Now under Construction	0.2	3.4	3.5	3.5	7.8	8.5	7.4	5.2	4.7	4.6	4.4
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	1.1	2.5	2.0	1.1	1.5
Far East Subtotal	3.8	6.9	6.9	6.8	11.1	11.7	11.6	10.7	9.6	8.5	8.7
Other Free World[3]:											
Reactors now Operational	2.1	2.1	2.1	2.1	2.0	2.0	1.9	1.9	1.8	1.7	1.6
Now under Construction	0.6	1.0	3.0	3.8	3.1	2.6	4.0	4.0	3.2	3.1	3.4
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	1.6	2.2	0.8	1.1
Other Subtotal	2.7	3.1	5.1	5.9	5.1	4.6	5.9	7.5	7.2	5.6	6.1
FREE WORLD[3] TOTAL	40.4	56.5	63.8	75.2	77.4	85.4	91.0	98.2	96.8	97.8	97.8
WORLDWIDE BREAKDOWN BY STATUS											
Reactors now Operational	34.5	35.3	36.0	36.7	37.1	37.2	36.9	36.6	35.7	34.5	33.7
Now under Construction	5.9	21.2	27.8	38.5	40.3	46.0	49.8	48.8	48.5	51.7	52.5
Now on Order	-0-	-0-	-0-	-0-	-0-	2.2	4.3	12.8	12.6	11.6	11.6

---

[1] Computed quantities of U_3O_8 which would be used under the given conditions, to fabricate fuel for loading and reloading reactors operating, under construction or on order as of October 31, 1980. Compiled and computed on a reactor-by-reactor basis, quantities for each reactor are based on specific core characteristics, 0.25% tails assay, no recycling, 24-month lead time for procuring first cores and 18-month lead time for procuring each reload. Where reload schedule is not already known, these estimates assume reloads occur one year after commercial operating date and annually thereafter. Nuexco estimates of individual reactor capacity factors are used.

[2] Japan, Korea, People's Republic of China, Taiwan.

[3] Excludes Bulgaria, Czechoslovakia, German Democratic Republic, Finland (two Russian Reactors), Hungary, Poland, Romania, USSR.

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Table 2
NUCLEAR ELECTRIC GENERATING CAPACITY[1] [2]
(thousands of MWe—net)

BUYER GROUP	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
United States											
Reactors now Operational	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8
Now under Construction	-0-	3.2	8.2	14.7	21.5	28.2	34.6	41.1	47.1	54.3	60.8
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
US Subtotal	50.8	54.0	59.0	65.5	72.3	79.0	85.4	91.9	97.9	105.1	111.6
Europe											
Reactors now Operational	16.3	16.3	35.4	35.4	35.3	35.3	34.7	34.7	34.4	32.6	31.2
Now under Construction	3.6	13.7	25.6	35.4	41.8	51.6	55.3	59.2	63.3	66.8	66.8
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	1.3	4.4	10.9	21.6
Europe Subtotal	39.4	49.3	61.0	70.8	77.1	86.9	90.0	95.2	102.1	110.3	119.6
Far East[3]											
Reactors now Operational	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
Now under Construction	-0-	0.5	1.5	4.7	6.7	8.6	14.3	19.0	21.8	21.8	21.8
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	1.1	3.0	3.9
Far East Subtotal	16.3	16.8	17.8	21.0	23.0	24.9	30.6	35.3	39.2	41.1	42.0
Other Free World[4]											
Reactors now Operational	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Now under Construction	-0-	0.8	1.7	3.6	7.0	10.1	11.1	11.8	13.1	13.7	13.7
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	2.1	3.6
Other Subtotal	6.5	7.3	8.2	10.1	13.5	16.6	17.6	18.3	19.6	22.3	23.8
FREE WORLD TOTAL	113.0	127.4	146.0	167.4	185.9	207.4	223.6	240.7	258.8	278.8	297.0
WORLDWIDE BREAKDOWN BY STATUS											
Reactors now Operational	109.4	109.2	109.0	109.0	108.9	108.9	108.3	108.3	108.0	106.2	104.8
Now under Construction	3.6	18.2	37.0	58.4	77.0	98.5	115.3	131.1	145.3	156.6	163.1
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	1.3	5	16.0	29.1

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[1] Installed as of year end.

[2] Uses Nuexco estimates of commercial operating dates.

[3] Japan, Korea, People's Republic of China, Taiwan.

[4] Excludes Bulgaria, Czechoslovakia, German Democratic Republic, Finland (two Russian reactors), Hungary, Poland, Romania, USSR.

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Table 3

COMPARISON OF NUEXCO ESTIMATES OF US APPARENT FUTURE CONSUMPTION: REPORT 144 (AUGUST 1980) VS. REPORT 147 (NOVEMBER 1980)

(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
US Reactors Operational											
Report 144	17.1	17.4	17.1	18.0	18.0	18.1	17.4	17.6	18.3	18.2	17.7
Report 147	16.0	16.3	16.6	17.0	17.2	17.3	17.3	17.2	17.1	17.0	16.8
Annual Difference	1.1	1.1	0.5	1.0	0.8	0.8	0.1	0.4	1.2	1.2	0.9
US Reactors under Construction											
Report 144	0.7	7.5	12.8	17.32	22.2	25.4	30.0	27.1	30.3	27.2	27.6
Report 147	0.7	4.6	6.3	10.1	13.2	15.5	18.2	17.9	20.5	23.4	23.5
Annual Difference	-0-	2.9	6.5	7.1	9.0	9.9	11.8	9.2	9.8	3.8	4.1
US Reactors on Order											
Report 144	-0-	-0-	-0-	-0-	-0-	-0-	0.9	0.3	0.3	3.1	2.0
Report 147	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Annual Difference	-0-	-0-	-0-	-0-	-0-	-0-	0.9	0.3	0.3	3.1	2.0
Total											
Annual Difference	1.1	4.0	7.0	8.1	9.8	10.7	12.8	9.9	11.3	8.1	7.0
Cumulative Difference	1.1	5.1	12.1	20.5	30.3	41.0	53.8	63.7	75.0	83.1	90.1

Table 4

FORECAST IMPROVEMENTS IN FUEL EXPOSURE

(megawatt-days per metric ton uranium)

Reactor Type	1980-1984	1985-1989	1990-1995
BWR	28,400	35,600	47,000
HWR	6,300	7,600	19,750[1]
PWR	33,360	43,900	50,650

[1] Includes enrichment of reloads to an average of 1.20 percent U_3O_8.

Table 5

COMPARISON OF NUEXCO FORECASTS OF INSTALLED NUCLEAR ELECTRIC GENERATING CAPACITY IN THE YEAR 1990

(thousands of megawatts)

	Report 144 (August 1980)	Report 147 (November 1980)	Difference
US	134.9	111.6	-17%
Europe	126.7	119.6	- 6%
Far East	41.2	42.0	+ 2%
Other Free World	23.8	23.8	-0-
TOTALS	326.6	297.0	- 9%

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worldwide decline in installed capacity of about ten percent, but the decline is concentrated heavily in the US.

Nuexco's current forecast of installed nuclear capacity is based upon:

1. In the US, the US Nuclear Regulatory Commission (USNRC) caseload and other institutional constraints on the rate of addition of nuclear capacity;

2. Construction progress to date for individual nuclear plants, and the owner utility's construction experience for conventional as well as nuclear units;

3. The owner utility's financial condition and the estimated likelihood of relief from ratemaking bodies.

Table 6 is a comparison between Nuexco's current forecast of installed capacity and that of the Energy Information Administration (EIA) of USDOE. The Nuexco forecast is below the EIA low case both for the US and for the rest of the world.

Methodology: In order to facilitate interpretation of the results presented, the methodology used in developing the concept of Apparent Future Consumption is summarized below:

1. Forecasts of Apparent Future Consumption are not forecasts of actual uranium demand. Rather, these forecasts comprise a portion of uranium demand more commonly referred to as reactor demand or reactor requirements. As indicators of the amount of uranium which will be needed to fuel the reactors under consideration, these forecasts should be regarded as relatively hard demand in the sense that this portion of demand is quite insensitive to uranium prices. Market demand for the assumed pattern of capacity additions can be higher or lower, depending on user's inventory policies.

2. Factors which can cause demand to exceed Apparent Future Consumption are:

a. Utility buyers plan their procurement strategies to achieve a very high probability of having access to at least enough uranium to meet commitments as they arise;

b. Accelerated reactor construction schedules can advance the dates of uranium need;

c. Buyers may elect to purchase uranium in excess of need, simply to enhance security of supply.

d. Utility obligations to suppliers of fuel cycle services such as conversion, enrichment or fabrication, may require earlier purchase of uranium than a reactor's operating schedule would otherwise indicate.

3. Demand can fall short of Apparent Future Consumption if uranium inventories are reduced in order to fill needs which would otherwise appear as demand.

Table 6

NUCLEAR GENERATION CAPACITY FORECAST FOR 1990

(thousands of megawatts)

	EIA[1] (Low-High)	Nuexco
OECD Countries		
Australia New Zealand	-0-	-0-
Austria Switzerland	2.9-2.9	2.9
Benelux Denmark	6.0-6.0	5.9
Canada	13.4-14.2	11.8
France	38.5-44.2	40.9
Germany	22.5-27.5	18.0
Greece Turkey	-0-	-0-
Italy	3.4-4.3	3.4
Japan	21.5-30.9	27.7
Scandinavia	12.6	10.5[2]
Spain Portugal	9.3-13.2	8.4
United Kingdom Ireland	11.6-13.4	8.2
Subtotal	145-170	138
United States	121-139	112
Non-OECD Countries		
Argentina	1.5-2.1	0.9
Brazil	1.9-3.1	1.9
India	1.9-2.1	1.7
Korea	5.5-7.4	5.4
Mexico	1.3-2.6	1.3
Pakistan	0.1-0.7	0.1
Philippines	0.6-0.6	0.6
South Africa	1.8-2.7	1.8
Taiwan	4.9-6.7	4.9
Yugoslavia	0.6-1.2	0.6
Subtotal	20-30	19
TOTAL	286-339	269

[1] Source: 1979 Annual Report to Congress, Energy Information Administration, Volume 3, pages 34 and 108.

[2] Includes, for purposes of comparison, two reactors fueled by the USSR.

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4. Apparent Future Consumption is based on information available today, subject to frequent revision as the date of consumption draws nearer.

5. Uranium is deemed to have been consumed when it has entered the enrichment-fabrication pipeline for ultimate use in a reactor.

6. Reactor loading is calculated for each reactor type, based on its particular reactor physics.

7. The forecasts assume that:

a. U_3O_8 deliveries for first cores predate commercial operation by two years.

b. U_3O_8 delivery for each reload predates refueling outage by 18 months.

8. Using the assumptions listed above, the consumption for a given reactor can be computed as a function of capacity factor, tails assay and commercial operating date.

9. Reactors fueled by the USSR are excluded from Nuexco's forecasts. Although Soviet bloc reactors account for substantial demand, Soviet participation in uranium trading in the Western market has been negligible and appears likely to remain so.

10. Actual commercial operating dates can vary widely from published dates. Nuexco uses the best information available, much of it from unpublished sources, to prepare its own forecasts of operating dates.

11. These forecasts make no provision for orders not yet placed. Only the consumption associated with reactors operating, under construction or on order are included.

12. The total of approximately 51,000 MWe (net) in Table 2 under the classification of *Reactors Now Operational* in the US is based on 69 reactors. Shippingport and Hanford are not included. Arkansas Nuclear unit 2 is included in the *Reactors Now Operational* category because it was declared commercial on April 25, 1980. Sequoyah unit 1, North Anna unit 2, Salem unit 2 and Farley unit 2 are not included becuase they have not yet been declared commercial. Consumption forecasts for the latter reactors were included under the category of *Reactors Now Under Construction*. Included in the 69 reactors are Humboldt Bay, and TMI unit 2, even though these plants are indefinitely shut down. Consumption forecasts included in Table 1 for the latter two units reflect their non-operational status.

Forecast of Uranium Production

This Report presents Nuexco's latest forecasts of uranium production for the world outside Communist areas (WOCA). Those forecasts are tabulated in Tables 7, 8 and 9. Table 7 summarizes Nuexco's forecast of US production of U_3O_8 for centers operating or under construction as of October 31, 1980. Table 8 shows estimated world uranium production by region; Table 9 contains the same production estimates segmented according to status of the production center.

Production centers are divided into categories, according to stage of development, as follows:

1. Operating production centers—those which have shipped U_3O_8 in commercial quantities before November 1, 1980.

2. Production centers under construction—those which were being built as of October 31, 1980, and which have an established access to ore reserves. Conventional production centers are included in this category only if mill construction has actually begun.

Each category is further divided, according to source, as follows:

- Conventional milling
- Unconventional recovery methods
  - —Solution mining, including *in situ* leaching and hydraulic mining.
  - —Phosphoric acid by-product recovery.
  - —Heap leaching, including leachings of tailings and copper dumps.

Nuexco presented estimates of world production of U_3O_8 in Report 141. In recognition of the market conditions prevailing at that time, those estimates were based only on facilities which were operating or under construction as of April 30, 1980. The following is excerpted from Nuexco Report 141:

> . . . *In the US, some existing facilities have begun to reduce production. Some can be expected to suspend production within the next one to three years if present trends continue. The estimate of US uranium production presented in this Report is based upon Nuexco's assessment of the probable output of each producer, which in turn is based upon estimated production cost, ore reserves, and sales commitments.*

During the past year, the economics of uranium production have been changing quite rapidly. As spot market prices have dropped, the amount of current US production which has become vulnerable to premature shutdown has increased. In addition, plans for construction of additional facilities have been and

Table 7

US URANIUM PRODUCTION FORECAST

(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	19871	1988	1989	1990
OPERATING											
Conventional Mills	28.5	21.4	19.1	18.4	16.8	14.3	13.7	13.0	11.4	10.9	10.4
Unconventional Souces	5.6	6.1	6.0	5.6	5.0	4.6	3.6	3.4	3.4	3.4	3.4
Subtotal	34.1	27.5	25.1	24.0	21.8	18.9	17.3	16.4	14.8	14.3	13.8
UNDER CONSTRUCTION (as of 10/31/80)	0.1	1.5	1.8	2.1	2.2	2.2	2.2	2.0	2.0	2.0	2.0
TOTAL (rounded)	34	29	27	26	24	21	20	18	17	16	16

Table 8

WORLD URANIUM PRODUCTION FORECAST[1]

(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Australia	2.8	5.8	10.8	10.8	10.8	12.0	15.0	15.0	15.0	15.0	12.0
Canada	18.0	16.4	19.6	19.4	22.2	23.0	25.0	27.0	27.4	27.4	27.4
Niger, Gabon	13.1	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
France	5.4	7.4	7.7	7.8	8.3	8.3	8.3	8.3	8.3	8.3	8.6
Namibia	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Republic of South Africa	15.4	18.9	19.8	20.4	20.9	21.3	21.7	21.5	21.5	21.4	21.4
Other Nations[2]	1.3	1.4	1.5	2.5	2.7	3.2	3.2	3.2	3.2	3.2	3.2
Non-US Total	66.0	75.2	81.7	86.2	90.2	93.1	98.5	100.3	100.7	100.6	97.9
US[3]	34.2	29.0	26.9	26.1	24.0	21.1	19.5	18.4	16.8	16.3	15.8
TOTAL (rounded)	100	104	112	112	114	114	118	119	118	117	114

[1] Outside Communist Areas.

[2] Includes Argentina, Belgium, Brazil, Chile, Portugal, Spain, and others.

[3] This Report, Table 7.

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Table 9
WORLD URANIUM PRODUCTION FORECAST[1]
(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
OPERATING											
US	34.1	27.5	25.1	24.0	21.8	18.9	17.3	16.4	14.8	14.3	13.8
Non-US	66.0	70.5	71.9	71.9	72.1	69.5	69.9	69.7	69.7	69.6	66.9
Subtotal	100.1	98.0	97.0	95.9	93.9	88.4	87.2	86.1	84.5	83.9	80.7
UNDER CONSTRUCTION											
US	0.1	4.5	1.8	2.1	2.2	2.2	2.2	2.0	2.0	2.0	2.0
Non-US	-0-	1.7	12.8	14.3	16.1	16.6	16.6	16.6	16.6	16.6	16.6
Subtotal	0.1	6.2	14.6	16.4	18.3	18.8	18.8	18.6	18.6	18.6	18.6
PLANNED											
US	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Non-US	-0-	-0-	-0-	-0-	2.0	7.0	12.0	14.0	14.4	14.4	14.4
TOTAL (rounded)	100	104	112	112	114	114	118	119	118	117	114

[1] Outside Communist Areas

continue to be reviewed. At the same time, heightened awareness of rising world inventory levels has increased the likelihood of a prolonged buyers' market.

In response to the rapid adjustments being made by US producers to the increasingly unfavorable economic outlook, Nuexco published in Report 145 a revised forecast of US production. The pace of shutdowns and cutbacks announced since that time has been such as to require a further downward revision in the US uranium production forecast.

Annual US production is expected to decline from the 1979 level of about 37 million pounds U_3O_8 to about 34 million pounds in 1980, about 20 million pounds in 1986 and about 16 million pounds in 1989. The decrease is due to declining ore grades, depletion of orebodies and production cutbacks due to high costs and low prices. It should be noted that Nuexco's forecast of 1980 US production, 34 million pounds, is 15 percent below the USDOE forecast presented at the October, 1980 Uranium Seminar in Grand Junction, Colorado. The difference between the two estimates is largely due to differences in perspective. The USDOE estimate represents the sum of responses for its mid-year marketing survey. Nuexco's estimate is a forecast which endeavors to make allowance for producers' expected reactions to worsening market conditions.

World production for 1979 totalled approximately 99 million pounds U_3O_8, of which non-US production accounted for 62 percent. Table 8 shows the US portion of the world's uranium production declining steadily from its 1979 level of 38 percent.

The continuing decline in spot market prices has begun to have significant effects on uranium production in the rest of the world, albeit more slowly and to a lesser extent than in the US. These effects have so far been limited primarily to commercial producers of uranium, as opposed to captive producers. Some plant expansions included in Nuexco's forecast of Report 141 have been removed from the forecast presented in this Report. Also, some older non-US production facilities can be expected to phase out due to the same pressures of high cost and low grade which affect so many US producers. Nevertheless, world production of uranium is forecast to increase by a total of 15 percent between 1980 and 1990. Decreases in production from the US and some older non-US facilities will be more than offset by production from facilities captive to aggressive national nuclear power programs as well as planned new production from high-grade reserves in Canada and Australia. It should be noted that the forecast presented herein includes, for the first time, forecast production before 1990 from Jabiluka in Australia and Key Lake and Midwest Lake in Canada. This step indicates Nuexco's belief that the economic incentives for developing those deposits are so compelling, espe-

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cially by comparison to the incentives for continuing the development, already under way, of deposits having much less favorable economics, that production from these facilities very likely begin in this decade.

The other important factor contributing to increasing production despite shutdowns and cutbacks by some commercial producers is production arising from facilities captive to aggressive national nuclear power programs. Active promotion of nuclear power by the governments of several nations allows them to use longer planning horizons than their US counterparts. Additionally, much of the important production outside the US is dedicated to attaining and sustaining national self-sufficiency in the nuclear fuel cycle, or at least in nuclear raw materials. For these reasons, much of what might otherwise be excess or economically marginal uranium production outside the US will continue in operation.

The forecast of world production presented herein necessarily reflects some subjective opionions about commercial decisions which will be faced over the next few years by uranium producers. The decisions include whether to:

1. Continue funding some projects already under construction;
2. Expand exploration programs, terminate them or to continue them at some intermediate level;
3. Postpone or terminate planned expansions;
4. Continue uneconomic or marginal mining and milling operations in the hope of near term improvement in the spot market price;
5. High-grade where possible, in effect sacrificing mine life for short-term improvements in average cost of production;
6. Divest themselves of less attractive mining or milling operations;
7. Withdraw altogether from uranium mining and milling.

Those decisions will be based on many factors, but the ultimate outcome of production decisions will most probably be determined by the economics of free market competition except for certain producers captive to electric utilities, and production capacity captive to national nuclear power programs.

Supply and Demand Balance

This section analyzes the resultant balance of uranium supply and demand, following some prefatory comments on definitions and computational groundrules.

1. With respect to the production forecasts, the critical assumption in this supply-demand analysis is that the forecast production will be sold, even if only for inventory accumulation in a time of apparent excess supply.

2. With respect to US production, the critical element in this supply-demand analysis is the degree to which producers having existing contracts will elect to purchase rather than produce uranium.

3. To the extent that actual annual demand exceeds consumption, inventory is accumulated.

4. It is worth reiterating that forecasts of apparent future consumption take no account of reactors not yet ordered. Consequently, consumption forecasts will understate actual demand by the amount attributable to orders yet to be placed, as well as by inventory purchases.

5. Inventory refers to uranium (U_3O_8, natural UF_6, enriched UF_6) owned by utilities, reactor manufacturers, fuel fabricators and national organizations which procure uranium for commercial purposes. The inventory amounts do not include strategic stockpiles, such as those owned by USDOE. Difficulties in accounting precisely for the variety of possible forms, locations and ownership of uranium inventory necessarily result in some uncertainty in estimating the total world uranium inventory. Nuexco's estimate of worldwide commercial uranium inventory as of the beginning of 1989 is approximately 250 million pounds U_3O_8 equivalent; however, the uncertainty factor of this estimate is ten to fifteen percent. More important is the fact that the primary conclusions of this analysis are not sensitive to beginning inventory variations of ten to fifteen percent.

Table 10 tabulates Nuexco's analysis of the uranium supply and demand balance for the world outside Communist areas. Conclusions which may be drawn from the analysis include the following:

1. Forecast production exceeds forecast consumption in each year through 1990. Supply and demand can be balanced by additions to inventory. In actual practice, if supply exceeds demand over an extended period, the necessary balance would probably result from a combination of inventory purchases and reduced production.

2. The world inventory of approximately 250 million pounds U_3O_8 equivalent at the beginning of

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Table 10

URANIUM SUPPLY-DEMAND BALANCE: WOCA[1]

(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
PRODUCTION[2]											
Operating Production Centers	100.1	98.0	97.0	95.9	93.9	88.4	87.2	86.1	84.5	83.9	80.7
Facilities under Construction	0.1	6.2	14.6	16.4	18.3	18.8	18.8	18.6	18.6	18.6	18.6
Planned Facilities	-0-	-0-	-0-	-0-	2.0	7.0	12.0	14.0	14.4	14.4	14.4
Total	100.2	104.2	111.6	112.3	114.2	114.2	118.0	118.7	117.5	116.9	113.7
less											
CONSUMPTION[3]	40.4	56.5	63.8	75.	77.4	85.4	91.0	98.2	97.8	97.8	97.8
equals											
NET INVENTORY INCREASE	59.8	47.7	47.8	37.1	36.8	28.8	27.0	20.5	20.7	19.1	15.9
plus											
BEGINNING INVENTORY	252.1[4]	311.9	359.6	407.4	444.5	481.3	510.1	537.1	557.6	578.3	597.4
equals											
ENDING INVENTORY	311.9	359.6	407.4	444.5	481.3	510.1	537.1	557.6	578.3	597.4	613.3
RELATIVE INVENTORY (years)[5]	6.2	5.5	5.6	5.4	5.7	5.6	5.6	5.5	5.8	5.9	6.1

[1] World outside Communist areas.
[2] This Report, Table 9.
[3] Natural uranium entering enrichment/fabrication pipeline for later use in a reactor. This Report, Table 4.
[4] Nuexco Estimate.
[5] For each year, Relative Inventory equals Beginning Inventory divided by Consumption.

1980 is equal to approximately six years of forward consumption at the 1980 rate. That inventory level is projected to more than double by 1990, reaching almost 600 million pounds U_3O_8 equivalent, which corresponds to approximately six years of forward consumption at the 1990 rate. In fact, the analysis indicates a stable relative inventory level throughout the decade; each year's relative inventory level falls in the range of 5.4 to 6.2 years of forward consumption. The relative inventory levels set forth in Table 10 are much larger than those published in Nuexco Report 145. The increase is partially due to the inclusion of enriched uranium in commercial inventory. The reason for this change in treatment of enriched UF_6 inventories is the fact that they have become commercially important for the first time, due to the rapid increase in size of enriched UF_6 inventories, especially over the past year, and due to increasing evidence of material being available for sale in the form of enriched UF_6. However the major reason for the increase in expected inventory levels is the substantial decrease in the forecast of Apparent Future Consumption published in this Report, compared to earlier Nuexco forecasts.

3. If actual demand is to be sufficient to support production from other production centers planned, but not yet under construction, it may arise from new reactor orders, or from political or national policy considerations. However, it is likely that a major driving force behind any such additional production entering the market would be the displacement of other higher-cost production centers.

Table 11 shows Nuexco's current analysis of the uranium supply and demand balance for the US. By treating the US alone, the potential market can be identified for imports and for potential US production centers not yet under construction.

The analysis in Table 11 is of the same basic form described above, but with the addition of an adjustment for *firm* US export-import commitments. The current US export-import balance, revised somewhat in this Report, is summarized in Table 12.

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URANIUM MARKET

Table 11

URANIUM SUPPLY-DEMAND BALANCE: US
(millions of pounds U_3O_8)

	1980	1981	1983	1983	1984	1985	1986	1987	1988	1989	1990
PRODUCTION[1]											
Operating Production Centers	34.1	27.5	25.1	24.0	21.8	18.9	17.3	16.4	14.8	14.3	13.8
Facilities Under Construction	0.1	1.5	1.8	2.1	2.2	2.2	2.2	2.0	2.0	2.0	2.0
Planned Facilities	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Total	34.2	29.0	26.9	26.1	24.0	21.1	19.5	18.4	16.8	16.3	15.8
less											
CONSUMPTION[2]											
Reactors Now Operational	16.0	16.3	16.6	17.0	17.2	17.3	17.3	17.2	17.1	17.0	16.8
Now Under Construction	0.7	4.6	6.3	10.1	13.2	15.5	18.2	17.9	20.5	23.4	23.5
Now on Order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Total	16.7	20.9	22.9	27.1	30.4	32.8	35.5	35.1	37.6	40.4	40.3
plus											
NET IMPORTS (EXPORTS)[3]	(2.5)	0.5	1.5	1.2	2.3	0.6	0.9	1.0	1.4	1.7	1.8
equals											
SUPPLY SURPLUS (DEFICIT)	15.0	8.6	5.5	0.2	(4.1)	(11.1)	(15.1)	(15.7)	(19.4)	(22.4)	(22.7)
plus											
BEGINNING INVENTORY	104.6[4]	119.6	128.2	133.7	133.9	129.8	118.7	103.6	87.9	68.5	46.1
equals											
ENDING INVENTORY	119.6	128.2	133.7	133.9	129.8	118.7	103.6	87.9	68.5	46.1	23.4
RELATIVE INVENTORY[5] (yrs)	6.3	5.7	5.6	4.9	4.4	4.0	3.3	3.0	2.3	1.7	1.1

[1] This Report, Table 7.
[2] This Report, Table 4.
[3] This Report, Table 12.
[4] USDOE, "Survey of United States Uranium Marketing Activity," DOE RA-0053 July 1980.
[5] For each year, Relative Inventory equals Beginning Inventory divided by Consumption.

Table 12

US IMPORT-EXPORT BALANCE
(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
IMPORTS											
Annual	5.9	6.1	6.8	5.5	5.4	2.6	2.5	2.5	2.5	2.5	2.5
Cumulative	5.9	12.0	18.8	24.3	29.7	32.3	34.8	37.3	39.8	42.3	44.8
EXPORTS											
Annual	8.4	5.6	5.3	4.3	3.1	2.0	1.6	1.5	1.1	0.8	0.7
Cumulative	8.4	14.0	19.3	23.6	26.7	28.7	30.3	31.8	32.9	33.7	34.4
NET IMPORTS (EXPORTS)											
Annual	(2.5)	0.5	1.5	1.2	2.3	0.6	0.9	1.0	1.4	1.7	1.8
Cumulative	(2.5)	(2.0)	(0.5)	0.7	3.0	3.6	4.5	5.5	6.9	8.6	10.4

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The result of the analysis in Table 11 is an annual supply surplus or deficit for the US. The annual beginning and ending inventory levels are also tabulated in Table 11 along with the relative inventory level for each year, in years of forward consumption. Table 11 indicates an annual US supply deficit beginning in 1984 and growing to an annual level of more than 15 million pounds by 1986. Without additional imports or new US supply, US inventory would decline to a level equivalent to 12 months forward consumption by 1990.

PUBLIC AND GOVERNMENT POLICY

In September, more than 1,500 participants from 75 countries gathered in Munich for the eleventh World Energy Conference. This triennial event, once viewed as a forum where technicians could gather to discuss common problems, has increasingly been politicized. Three national groupings have emerged; the oil producers, the industrialized nations and the developing countries. Differing problems and goals in the energy area reflect their differences in geography, religion and ethnic composition as well as their unique political, economic and national security considerations.

There was general agreement, however, on the scope of the problem. Total world energy demands, even with conservation, are expected to double by the year 2000 and come close to doubling again by 2020, while conventional oil production is expected to peak in 1990 and to decline thereafter. This suggests a vastly larger role for coal, natural gas and nuclear power if economic progress, particularly in the developing countries, is not to be stifled by an energy shortfall.

While coal has been viewed as picking up a substantial portion of expanded energy production, some doubt was cast at the Conference on its ability to live up to such expectations. Increased coal production of the magnitude required will mean enormous expansion in coal industry infrastructure, especially transportation and loading facilities, when at present there are plans neither to finance nor to build this expansion.

Substantial growth in nuclear power was generally viewed by Conference participants as absolutely essential. Nuclear power was viewed as a requirement to meet increased overall energy demands, as well as to displace existing oil and gas electrical generation.

Of particular note at the Conference was an address by Pyotr Neporozhny, Minister of Power and Electrification of the USSR. He predicted that total electric generating capacity in the USSR in the year 2000 would reach 500,000 MWE, or 2.5 times the current level, and gave highest priority to the development of nuclear electrical generation in the USSR and other Comecon countries.

AFRICA

Uranium production in the Republic of South Africa was 3.9 million pounds U_3O_8 in the third quarter 1980. This is down two percent from the previous quarter, but it represents an increase of 660,000 pounds U_3O_8 or 20 percent above the third quarter 1979. The increase is largely due to plant expansions which have been commissioned over the past year.

South African gold uranium producers normally announce their uranium profitability on a quarterly basis. The nation's largest producing company Vaal Reefs (produced 932,000 pounds U_3O_8 last quarter, or 24 percent of the total) announced profits of R 5.4 million last quarter, down 72 percent from R 19 million in the previous quarter. Vaal Reefs is an Anglo-American Group company, and the lower profits might reflect the uranium stockpiling policy to which the chairman of Anglo-American referred in his recent report to shareholders. He suggested that important quantities of uranium might be stockpiled by South African producers over the next few years, presumably to avoid putting further downward pressure on the near term market.

AUSTRALIA

Prime Minister Malcolm Fraser's coalition government was returned to power in Australia's general election held October 18. Final returns for the House of Representatives show the coalition of the Liberal and National Country Parties holding a 23 seat margin (74-51) over the Labor Party. Despite a net swing of 13 seats to the Labor party (the previous government held a 49-seat margin), the current 23-seat margin in the House of Representatives insures firm control for the Fraser goverament.

The situation is less clear in the 64-seat Senate where the Liberal-National Country coalition previously held clear control with 35 seats. Thirty-two

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seats were up for election, and while returns are still not final, it is likely that the coalition will hold 32 seats with Labor having 27, the Democrats 4, and one independent. The new Senate does not convene until July 1981, and it is expected that, before then, the necessary compromises will be effected to insure control by the Fraser government forces, even if it lacks a clear majority.

On balance, it appears that the Australian uranium industry can look forward to continued government support for the next three years.

In Nuexco Report 116 reference was made to a debit and credit system in the uranium supply contracts between ERA and its foreign shareholders. It should be noted that this provision is not applicable to the floor prices which are effective in 1985 and later years, but only with respect to the escalated prices payable in 1983 and 1984. Thus, if the escalated prices paid in 1983 and 1984 exceed international long-term market prices in those two years, there is provision for granting partial offsetting credits in later years. However, because ERA can never receive less than the floor price, such credits can only be recouped when (and presumably only to the extent) prices in such later years are higher than the floor prices.

EUROPE

France has increased its nuclear generating capacity 60 percent this year rising form 7,700 MWe in January 1980 to 12,200 MWe at present. The additional 4,500 MWe was provided by the following plants:

Reactor Name	**Full Power Date**
Dampierre unit 1	May 29, 1980
Gravelelnes unit 1	July 4, 1980
Gravelelnes unit 2	August 26, 1980
Tricastin unit 1	July 11, 1980
Tricastin unit 2	August 7, 1980

These five units are capable of producing about 30 billion kilowatt-hours per year, which will offset about 45 million barrels of oil annually.

The Soviet Union reports it will add between 7,000 and 10,000 MWe of nuclear generating capacity each year during the period 1981 through 1985. The new plants will be PWRs of 1,000 MWe nominal capacity. Rumania will soon start construction of the first of six Candu reactors of 660 MWe capacity each. During the first half of 1980, Western Europe ordered nine nuclear plants totaling 8,600 MWe. By contrast, in the US, ten plants totaling 11,000 MWe were canceled during the same period.

UNITED STATES

Nuclear electric power generation in the US totaled approximately 195 million megawatt-hours gross during the first three quarters of 1980. This is down from 206 million in the first three quarters of 1979, and 215 million in the same period of 1978. Thus the effects of the TMI accident continue to plague the industry. Table 13 tabulates monthly and quarterly US nuclear electric generation beginning with the third quarter of 1978. Quarterly nuclear electric generation was gradually increasing through the first quarter of 1979. The TMI accident happened at the end of the first quarter 1979, and the effects on production are apparent in Table 13. US nuclear generation fell from 81.5 million megawatt-hours in the first quarter 1979 to 52.2 million megawatt-hours in the second quarter 1979. (Some decrease would normally have been expected due to off-peak scheduled refueling outages in the spring.) Quarterly nuclear electric output has not approached the pre-TMI high.

The US Nuclear Regulatory Commission (USNRC) has issued the following operating licenses since the TMI accident:

1. Full-power operating license for Virginia Electric & Power Company's North Anna unit 2.
2. Full-power operating license to Tennessee Valley Authority's Sequoyah 1 unit.
3. Low-power testing license for Public Service Electric & Gas Company's Salem unit 2.
4. Low-power testing license for Alabama Power Company's Farley unit 2.

The USNRC has published (45FR 65521) the final regulations on Uranium Mill Tailings Licensing and the Final Generic Environmental Impact Statement on Uranium Milling. One major US producer has recently commenced litigation to attempt to overturn the USNRC's new tailings requirements.

Recent months have seen substantial revisions in the historical data of the US Bureau of Labor Statistics (BLS) industry employment series. Revisions in the Average Hourly Earnings data reprinted by Nu-

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Table 13

US NUCLEAR ELECTRIC POWER GENERATION

(millions of megawatt-hours, gross)

		Monthly	Quarterly
1978	July	26.2	
	August	27.3	
	September	23.4	76.9
	October	24.6	
	November	26.3	
	December	27.4	78.3
1979	January	29.2	
	February	27.3	
	March	25.0	81.5
	April	19.3	
	May	15.8	
	June	17.1	52.2
	July	22.5	
	August	26.1	
	September	23.2	71.8
	October	22.3	
	November	20.3	
	December	21.9	64.5
1980	January	21.1	
	February	20.8	
	March	21.2	63.1
	April	19.6	
	May	19.6	
	June	19.4	58.6
	July	22.4	
	August	15.6	
	September	21.8	72.8

exco are tabulated in the statistical data section of this Report. These data supersede those published in Nuexco Report 139.

The data revisions have arisen because the US BLS periodically adjusts its industry employment series to more recent bench marks to correct for sampling variability and for changes in industrial activity. Beginning with the July 1980 issue of "Employment and Earnings," published by the BLS, all data are adjusted to the latest benchmark available, March 1969, and are subject to revision from that point forward with the advent of the next benchmark scheduled for publication of mid-1981.

TRANSACTIONS

Five sales transactions are reported this month. A US producer sold from 101,000 to 300,000 pounds U_3O_8 to a US utility for delivery in late 1981. A US producer sold a small lot under 50,000 pounds to a US producer for immediate delivery. A long term transaction was concluded between an Australian producer and a European utility with deliveries commencing in 1982 and stretching over 15 years. A European organization sold between 101,000 and 300,000 pounds to a European utility for immediate delivery. Finally, a US nuclear contractor sold between 601,000 and 1,000,000 pounds U_3O_8 equivalent as UF_6 to a US utility for delivery in 1981.

PRICING

This month's market activity indicates that prices are still softening, since it is necessary to cut prices to move material. Accordingly, the Exchange Value declined again to $28.00, from $28.50 last month.

Market pressures seem to be all in the downward direction. Near term demand is not only thin, but largely discretionary, since it consists mainly of producers interested in buying rather than making, plus a few utilities purchasing for inventory. Total uranium available for sale (see Market Opportunities section of this Report) and delivery over the next year is about 7.4 million pounds U_3O_8 equivalent, of which about 5.5 million pounds is from inventory holders. The total of inquiries to buy over the next year is 1.1 million pounds. Supply is still much greater than demand, as it has been over the past several months. This imbalance has lead to aggressive price competition among sellers.

Activity has become focused on the longer term. It is now possible for a buyer to receive multiple offers from US, Canadian, and Australian sellers in response to inquiries for intermediate and long term supply. Several US buyers are now in the process of evaluating long term offers.

CONVERSION

Inquiries to sell conversion services on the secondary market over the next year currently total about 1.5 million pounds U in UF_6. Some of these inquiries come from uranium inventory holders interested in selling uranium inventory. These sellers

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have found there is more interest among uranium purchasers if the form of the material being marketed is concentrates, rather than UF_6. This is because the potential buyers are often uranium producers, which, if they purchase at all, usually must purchase uranium in the form of concentrates since their preexisting delivery obligations are for concentrates. Also, utility buyers are normally interested in purchasing uranium in the form of concentrates rather than UF_6 because they usually have preexisting conversion obligations which cannot be met if they buy UF_6. This helps explain the selling pressure on the secondary conversion market.

Thus it appears that the conversion market is now multi-faceted. In the longer term market, it appears that conversion services are available only from the primary conversion contractors. The price in the longer term primary market is determined by separate forces from those affecting the near term, secondary market. The near term market has two major forces influencing it. The first is the uranium inventory holders which own UF_6 and want to sell it, but can only sell the inventory if it is in the form of concentrates. This group is interested in selling conversion services in order to, in effect, *deconvert* their UF_6. The deconversion would take the form of a swap of UF_6 for concentrates, with a consideration paid for the conversion services as agreed to by the parties. The price at which conversion services would be available for sale by these sellers is largely determined, not by the value of the conversion, but by the pressure on the inventory holder to sell the uranium. Thus the driving force on conversion price in this secondary market is indirectly determined by uranium supply and demand.

There is another, currently less important facet, of the conversion market. A few secondary sellers of conversion services are interested in selling only conversion services; there is not pressure to sell uranium driving the conversion sale. These sellers have, however, been relatively unimportant recently because downward pressure on the near term secondary conversion market from potential uranium inventory holders has resulted in very low conversion prices in this market. This situation can be expected to continue as long as uranium inventory holders remain active as sellers, since most inventory is held in the form of UF_6.

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TOPICAL ESSAY

THE EFFECT OF INVENTORY SALES ON THE URANIUM MARKET IN 1980

In the first ten months of 1980 uranium prices dropped significantly. As measured by Nuexco's Exchange Value this decline has amounted to \$12.75, from \$40.75 per pound U_3O_8 as of December 31, 1979 to \$28.00 per pound U_3O_8 as of October 31, 1980.

The primary factor in this price decline is, of course, the supply demand imbalance. Table 10 of this Report indicates that the 1980 beginning of year world inventory level was about 250 million pounds U_3O_8 equivalent. This represents about six years of world consumption at current rates. This inventory level has increased during 1980 and is expected to continue to increase during the next several years. In addition there is persuasive evidence of the existence of enormous uranium resources worldwide. Thus, buyers view the possibility of any uranium shortage in the coming decade as very remote.

However, the precipitous decline in the Exchange Value during the past ten months cannot be attributed only to a sudden awareness of a supply demand imbalance. It is apparent that the price decline has been hastened by other market factors, one of which is the availability for sale of uranium inventory.

Table 14 is a tabulation of spot and near term sales transactions reported in the Nuexco Monthly Report during 1980. Table 15 contains intermediate and long term transactions reported by Nuexco during the same time period. Although the intermediate and long term transactions involved six times as much material as the spot and near term transactions, it is these shorter term sales which determine the current market price. This is because most of the longer term transactions have pricing provisions which are related to either production cost, or market price at the time of delivery, often subject to a floor price. The nearer term contracts, on the other hand, tend to be fixed price arrangements.

Table 14 indicates that producers have been more important than non-producers as sellers in the near term market, both in terms of number of transactions and quantity of material sold. However, there have been a significant number of sales by nonproducers, sales amounting to more than one-third of the spot and near term material delivered. This selling pressure has persisted, as indicated by the fact that of the 7.4 million pounds U_3O_8 available for sale and delivery within the next year (see Market Opportunities Section of this Report), about 5.5 million pounds is being offered by non-producers. The market activity of inventory holders has thus served as sort of a catalyst in speeding a price drop that probably would have happened as a logical reaction to fundamental market pressures. In the longer term, inventory sales might lead to an overreaction, pushing prices below the level they would have otherwise reached.

The reason that uranium inventory holders have had these effects on the market stems from uranium's unique characteristics as a commodity. With most commodities, consumer inventories act as a *surge tank*. Market prices vary in a roughly cyclical pattern, and inventories react accordingly. As supply grows relatively short, the market price increases, and buyers will either reduce inventory levels or use substitute materials. Similarly, when supply becomes abundant and the market price declines, buyers frequently will choose this time to increase inventories as well as increase the use of the material. Such action on the part of buyers will tend to increase demand, the market price will eventually rise and the cycle will start again.

Uranium deviates in several important respects from this standard model. The first is that uranium is a single purpose commodity with no use other than for electrical power generation. No matter how low the price of uranium drops, the only commercial users of uranium will be electric utilities. Similarly, once a nuclear plant is in place there is no substitute for uranium, no matter how high the price. Thus there is no cross-elasticity of demand for uranium, over the short term. This constrains the supply demand relationship because as the price goes up and down there are relatively few additions to or departures from the consumer group. Thus demand for uranium is relatively inelastic over the short term.

Uranium deviates from the standard model in a second important respect, that is the sheer magnitude of the current inventory levels. Earlier uranium commitments combined with later reactor delays and cancellations have caused many utilities to accumulate far more uranium than had been anticipated or that any logical inventory policy would dictate. Inventories, moreover, are dispersed. Several US utilities have the capability to offer in excess of five million pounds for sale on the near term market. When inventories reach these levels, not only does the market price drop in response to decreased demand,

TOPICAL ESSAY

Table 14

SPOT AND NEAR TERM[1] SALES TRANSACTIONS REPORTED IN THE NUEXCO MONTHLY REPORT DURING 1980[2]

(number of transactions and thousands of pounds U_3O_8 involved)

	Buyer				
Seller	US Producer	US Non-Producer	Non-US Producer	Non-US Non-Producer	Total
US Producer[3]	6 (850)	7 (1,141)	—	7 (1,161)	20 (3,152)
US Non-Producer[4]	6 (1,055)	4 (1,176)	—	3 (385)	13 (2,616)
Non-US Producer	—	1 (750)	2 (370)	3 (750)	6 (1,870)
Non-US Non-Producer	—	1 (210)	1 (210)	1 (28)	3 (448)
TOTALS	12 (1,905)	13 (2,677)	3 (580)	14 (2,324)	42 (8,386)

[1] Near term means delivery within one year after contract signature.

[2] Nuexco Reports 138 through 147.

[3] "Producer" means companies directly involved in mining uranium.

[4] "Non-producer" includes utilities, government agencies, fuel fabricators and others not directly involved in mining uranium.

Table 15

INTERMEDIATE[1] AND LONG TERM[2] SALES TRANSACTIONS REPORTED IN THE NUEXCO MONTHLY REPORT DURING 1980[3]

(number of transactions and thousands of pounds U_3O_8 involved)

	Buyer				
Seller	US Producer	US Non-Producer	Non-US Producer	Non-US Non-Producer	Total
US Producer[4]	—	2 (3,430)	—	4 (4,110)	6 (7,540)
US Non-Producer[5]	—	—	—	—	—
Non-US Producer	—	1 (4,500)	—	6 (30,640)	7 (35,140)
Non-US Non-Producer	—	—	—	—	—
TOTALS	—	3 (7,930)	—	10 (34,750)	13 (42,680)

[1] Delivery extends more than one year and less than five years after contract signature.

[2] Delivery extends more than five years beyond contract signature.

[3] Nuexco Reports 138 through 147.

[4] "Producer" means all companies directly involved in mining of uranium.

[5] "Non-Producer" includes utilities, government agencies, fuel fabricators, and others not directly involved in mining uranium.

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but the situation is aggravated by the perceived potential and actual availability of supply from inventory holders. Even a small group of utilities, should their decisions to sell coincide, could create an overwhelming near term supply imbalance with a further significant impact on the market price.

The final deviation from the standard model is that uranium is a commodity which passes commercially directly from producer to end user. With many commodities, there are intermediary firms which purchase the material, process it, and sell it to the end user or another intermediary firm. This tends to increase the number of available *surge tanks* in which inventory can be held. In the uranium industry, where title to the material generally passes directly to the end user, there is no cushioning effect of intermediate owners of the material, thus excess supply is quickly felt in terms of large inventories in the hands of consumers. Further, because producers sell uranium directly to end users, the potential for end users to then sell back to producers is increased due to the preexisting buyer seller relationships.

These factors in aggregate make it both possible and in some cases very practical for inventory holders to sell, or at least consider selling material. The fact that a significant number of holders have so opted helps to explain why inventory holders have had a hastening effect on the decline in the market during 1980.

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THE RANGER PROJECT

The Ranger Project is located about 200 kilometers east of Darwin, Northern Territory, on the east flank of the Pine Creek Geosyncline. It was initiated as an exploration venture owned by EZ Industries Ltd. and Peko-Wallsend Ltd. The two companies operated under the name of Geopeko Ltd. during the initial drilling on the Ranger No. 1 and No. 3 orebodies. A managing company, Ranger Uranium Mines Pty., Ltd., was later formed to continue the orebody evaluation. In 1975, the Australian Atomic Energy Commission (AAEC) agreed to provide 72½ percent of the capital required for continuing project exploration and development in return for a 50 percent interest in the project. Peko and EZ agreed to finance the remaining 27½ percent and each would retain a 25 percent interest. Property evaluation continued under the direction of Ranger Uranium Mines.

Project ownership essentially remained unchanged until September 30, 1980, when the joint venturers assigned their interest in the Ranger Project for cash consideration and stock in a newly formed company—Energy Resources of Australia, Ltd. (ERA). The terms of the transaction were described in detail in Nuexco Report 146.

Production from the Ranger project is scheduled to begin in late 1981 at a rate of 3,000 tonnes U_3O_8 per year. Figure 1 is a location map of the Ranger Project area showing the relationship to other uranium deposits within the Pine Creek Geosyncline. Figure 2 is a recent aerial photograph of the Ranger site.

History

The East Alligator River region became of interest to prospectors following an announcement by the Australian Bureau of Mineral Resources in 1968 that Archean and Lower Proterozoic rocks had been tentatively identified in the area. This indicated a geologic and possible mineralogic analogy to that of the uranium-rich Rum Jungle region on the west side of the Pine Creek Geosyncline. Consequently, prospecting of the East Alligator River region began almost immediately.

Geopeko Ltd. was one of several companies to obtain an authority to prospect in the area in 1968. Due to the lack of rock outcropings throughout the region, aerial surveys utilizing radiation detection instruments became the favored exploration technique. In early 1969, Noranda (Australia) Ltd. located several relatively intense radioactive anomalies within the limits of its own permit area and at least one important anomaly on the Geopeko permit. Follow-up evaluation of the anomalies by ground crews from each company resulted in the eventual discovery of the Ranger No. 1 and No. 3 orebodies by Geopeko and the Koongarra deposit by Noranda.

Geopeko eventually outlined six radiometric anomalies within about 6,000 meters along a north south trend near the southern limits of their permit area. A percussion and diamond drill program was initiated on anomalies No. 1 and No. 3. A total of 13 holes was drilled on 100 meter spacing. Uranium mineralization was encountered at the surface and to a depth of about 200 meters. In October 1970, the Geopeko joint venture announced the discovery of indicated uranium resources totaling 70,000 tonnes of contained U_3O_8. Figure 3 is a radiometric anomaly map of the Ranger area showing the anomaly relationship of the No. 1 and No. 3 orebodies. Evaluation of the remaining anomalies has yet to be completed.

Diamond drilling was resumed on the No. 1 orebody in 1971 on a hole spacing of 50 meters. A number of cores were taken from different ore zones to determine ore characteristics for future mining and milling. The orebody was eventually expanded to the approximate dimensions of 400 meters in length, 225 meters in width and 145 meters in thickness. Estimated ore reserves of No. 1 orebody as of January 22, 1980, assuming a mine cutoff grade of 0.10 percent U_3O_8 are 15,870,100 tonnes ore at an average grade of 0.33 percent U_3O_8. Total uranium content is 52,878 tonnes U_3O_8.

The second phase of diamond core drilling was initiated on the No. 3 orebody in October 1971, on a hole spacing of 100 meters. By late 1972, drilled out reserves of approximately 31,000 tonnes U_3O_8 had been estimated for the orebody. Evaluation has since continued intermittently and orebody dimensions now average approximately 650 meters in length, 400 meters in width and 100 meters in depth. Ore reserves for one No. 3 orebody as of on January 22, 1980, assuming a cutoff grade of 0.05 percent U_3O_8, are estimated at 28,786,000 tonnes ore at an average grade of 0.20 percent U_3O_8. Total uranium content of No. 3 orebody is 58,000 tonnes U_3O_8, however approximately 15,000 tonnes of the total are classified as *possible* ore.

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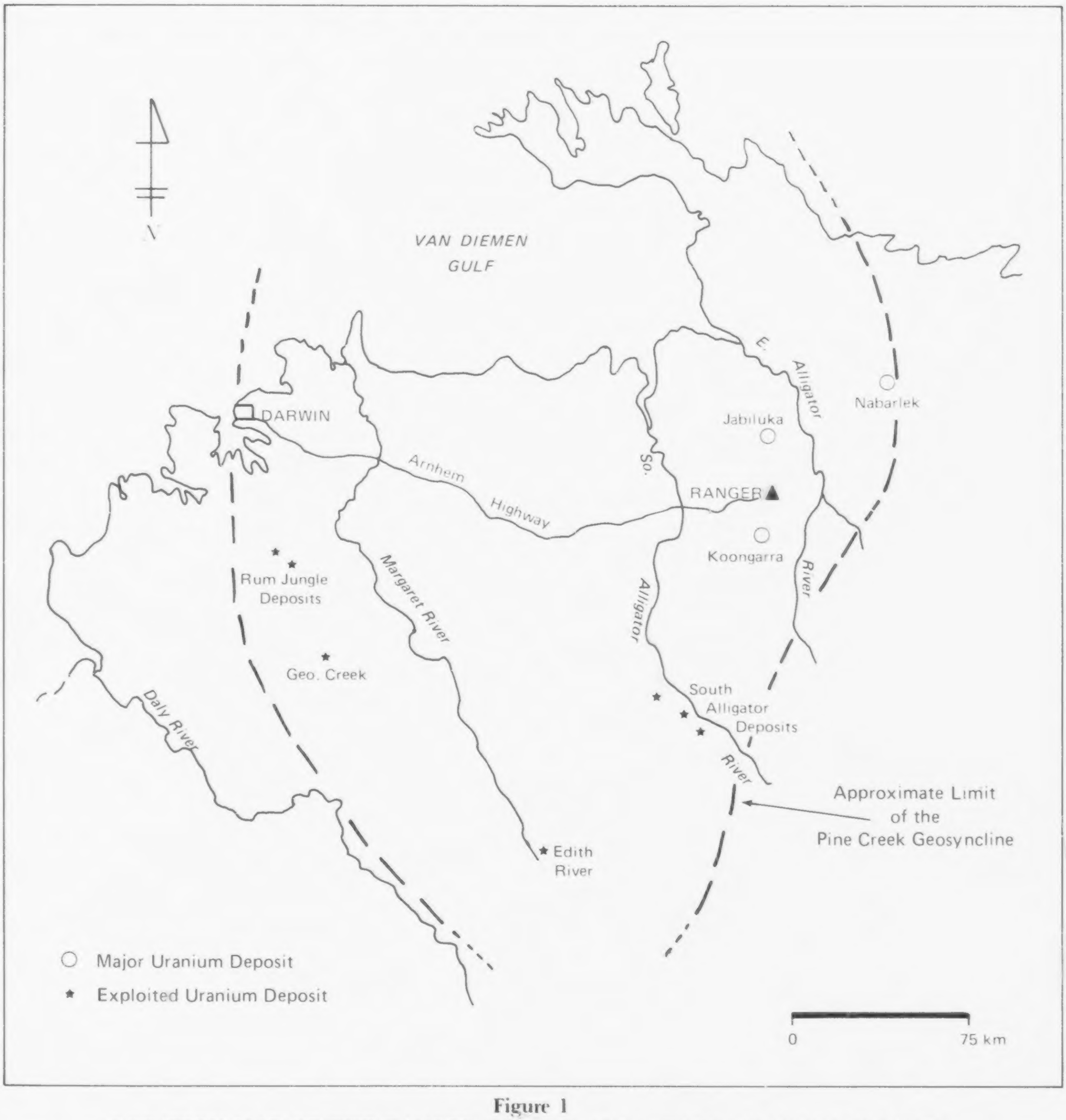
N
VAN DIEMEN
GULF
DARWIN
Arnhem
Highway
E.
Alligator
River
Nabarlek
Jabiluka
So.
Alligator
River
RANGER
Koongarra
Rum Jungle
Deposits
Margaret River
Geo. Creek
Daly River
South
Alligator
Deposits
Edith
River
Approximate Limit
of the
Pine Creek Geosyncline
○ Major Uranium Deposit
★ Exploited Uranium Deposit
0
75 km

Figure 1
LOCATION MAP OF THE RANGER DEPOSIT AND OTHER URANIUM DEPOSITS WITHIN THE PINE CREEK GEOSYNCLINE, NORTHERN TERRITORY, AUSTRALIA

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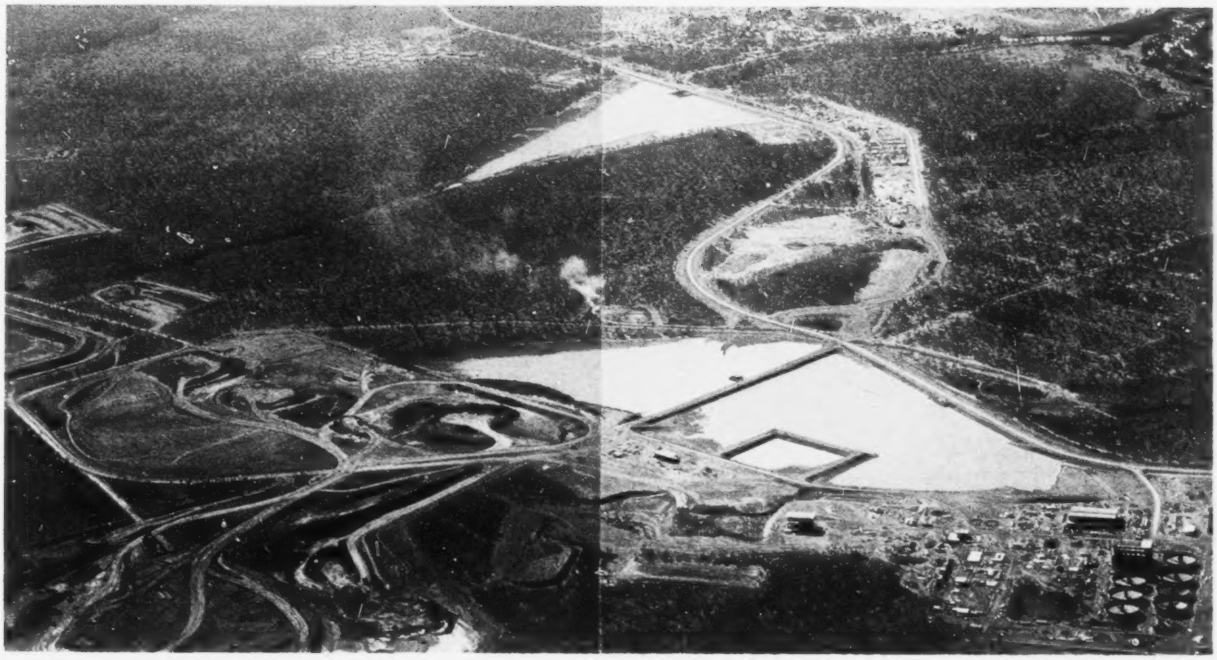

Figure 2
AERIAL VIEW OF THE RANGER SITE. THE OREBODY IS IN THE LEFT FOREGROUND. THE MILL IS ON THE RIGHT.

Geology

The Pine Creek Geosyncline represents the principal geologic feature of the entire region. Archean and Lower Proterozoic rocks have been moderately folded across the north south trending synclinorium,[1] which extends from the Rum Jungle area in the west to the East Alligator River area in the east. The major uranium orebodies in the Northern Territory, Ranger No. 1 and No. 3, Koongarra, Jabiluka and Nabarlek, all occur along the east flank of the synclinorium structure (see Figure 1).

The Archean rocks in the East Alligator River area consist of granite, schist and gneiss belonging to the Nanambu Complex which has been age dated at 2,500 to 1,800 million years (m.y.). Locally, this is referred to as the Footwall Sequence. The Footwall consists primarily of quartz-mica schist and sericite-quartz-feldspar gneiss which developed during a period of intense metamorphism at about 1,800 m.y.

The Footwall Sequence is unconformably overlain by the Lower Mine Sequence which occurs at the base of the Cahil Formation and is the earliest sedimentation of Lower Proterozoic Age. It is, in turn, overlain by the Upper Mine Sequence and the Hanging Wall Sequence to end deposition of the lower Cahill Formation. The upper member of the Cahill Formation consists of 2500 meters of fine grained sandstone and mica-quartz schists. It is in turn, overlain by the Nourlangia Schist, the youngest Lower Proterozoic meta-sedimentary unit in the district.

Each depositional sequence was intensely metamorphosed during renewed igneous activity consisting of intrusions of granite and pegmatite and basic dikes, all considered to be related to the Nanambu basement complex. Evidence of brecciation occurs along formation contacts, fault and fracture zones and alteration collapse features. Igneous activity and metamorphism began at about 1,800 m.y. and ended

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[1] A synclinal structure of regional extent wherein the formations have been folded repeatedly across the width of the structure.

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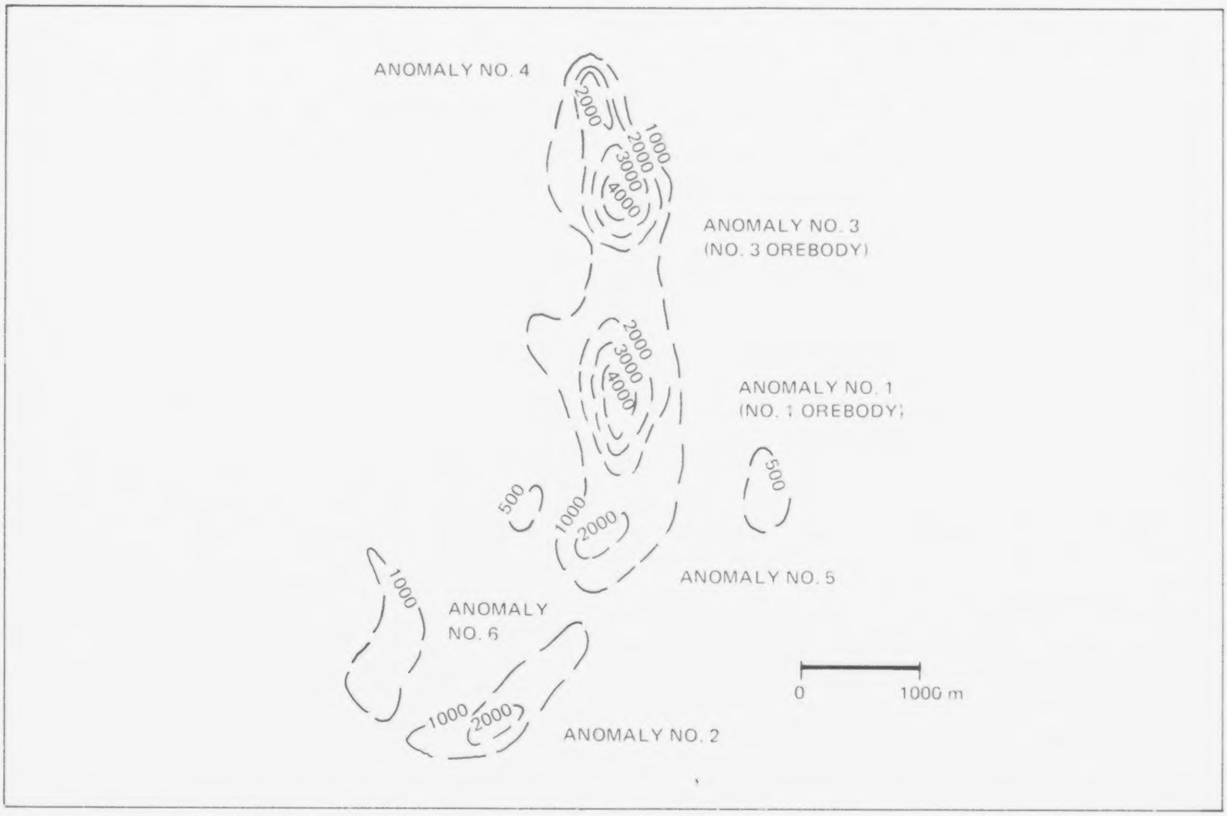

Figure 3
OUTLINE OF AERIAL RADIOMETRIC SURVEY, CONTOURS OF TOTAL COUNT

about 1,650 m.y.

The three lower units of the Cahil Formation primarily consist of intercalated dolomite, chert, quartzite and a series of chlorite, graphite and sericite biotite schists. The principal host rock for uranium mineralization is the chlorite and sericite biotite schist series. The formational units are described as follows, beginning with the lowest unit:

Lower Mine Sequence: This unit is about 250 meters thick. The lower portion consists of massive fine to medium grained magnesite dolomite marble. The middle portion which is less than 20 meters thick, is the main uranium-bearing zone in the unit and consists of chlorite-sericite schist. The upper part is predominantly dolomitic marble with chlorite lenses.

Upper Mine Sequence: The unit is about 150 meters thick consisting of biotite-quartz-feldspar schists and dolomitic marble and biotite-quartz schist with sericite lenses and stringers, all of which have been subjected to chloritization. The chloritized biotite-quartz-feldspar schists are the main host rocks for uranium mineralization in both Ranger orebodies. Carbonaceous material is common in the lower portion.

Hanging Wall Sequence: The unit is up to 40 meters thick and consists of coarse mica-feldspar-quartz schist and coarse grained sericite-chlorite schists with disseminated magnetite. Uneconomic uranium mineralization occurs in this unit.

The Lower Proterozoic was further metamorphosed and brecciated by intrusions of coarse quartz-feldspar-tourmaline pegmatites and dolerite dikes that show

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chloritization in association with uranium mineralization. This is the latest stage of intrusive action. It is considered to have taken place during Carpentarian time and is Middle Proterozoic in age.

Uranium Occurrences

All uranium deposits in the East Alligator River district, including the Ranger deposits, are considered to be stratebound deposits in the lower member of the Cahill Formation of Lower Proterozoic Age. Mineralization is always closely associated with the chloritic zones in the Upper Mine Sequence and the Lower Mine Sequence. The chlorite occurs as replacement of the mica minerals—biotite, muscovite and sericite—in all deposits except Nabarlek. Uranium occurs primarily with quartz-biotite-sericite-chlorite schists. All orebodies except Nabarlek are adjacent to massive bedded dolomite and or magnesite formations.

Ranger No. 1 orebody is primarily limited to chloritized biotite-quartz-feldspar schists in the Upper Mine Sequence; a small tonnage occurs in chloritic veins in a silicified carbonate of the Lower Mine Sequence at the very base of the Cahill Formation. The upper portion of the orebody occurs in a highly oxidized zone from the ground surface to a depth of about 35 meters. The oxidized zone is considered to be at the unconformable contact between the Lower Proterozoic and the overlying Middle Proterozoic.

About two million tonnes of ore in the Ranger district occurs in the oxidized zone. Secondary uranium minerals present in the oxidized zones consist of saleeite, sklodowskite, metatorbernite and a little gummite. Mineralization in the lower unoxidized portion of the orebody consists of vein-type and disseminated pitchblende, primarily within zones of brecciation and fractures associated with chlorite schists. Over 13 million tonnes of ore occurs in the unoxidized zone. The orebody contains gold in trace amounts, usually associated with other gangue minerals such as quartz, pyrite, chalcopyrite and galena, however, all such minerals occur in subeconomic concentrations. The dikes that intruded the Lower Proterozoic rocks during Carpentarian times are essentially unmineralized except along shear and fracture zones. Figure 4 is an east-west generalized geologic section through the No. 1 orebody. Note that the large portion of ore occurs in the Upper Mine Sequence (UMS) compared to ore in the Lower Mine Sequence (LMS), and that faulting was a controlling factor to the placement of mineralization.

The geology and mineralogy of the No. 3 orebody is similar to the No. 1 orebody. Essentially all ore occurs near the base of the Upper Mine Sequence in chlorite schists, directly above a thick chloritic carbonate zone. An insignificant amount of mineralization occurs at the base of the Lower Mine Sequence, in a brecciated chloritic carbonate host. The Carpentarian dikes and faulting common to the No. 1 orebody are almost nonexistent in the No. 3 orebody. The few dikes identified are not mineralized. Figure 5 is an east-west generalized geologic section through the No. 3 orebody. All ore is confined to the lower portion of the Upper Mine Sequence (UMS).

Mineralization in the No. 3 orebody is the same as No. 1 Orebody. The same suite of minerals occur in the oxidized zone which is 20 to 30 meters thick. There is evidence of secondary uranium mineralization trailing along the upper ore contact throughout the unoxidized zone. Pitchblende is the only important uranium mineral in the unoxidized portion of the orebody.

Ore Genesis

A favored theory regarding ore genesis suggests that the deposits formed by remobilization of uranium into favorable traps created by structural and solution activity. The primary trap environment for all deposits in the district is zones of brecciation and fracturing. The original source of uranium is considered to be the Archean granites which contain a higher uranium content than is normal in other granites. The uranium was remobilized during the structural and metamorphic activity at about 1,800 m.y. The mineralization was deposited with the overlying Kombolgie Sandstone as it was deposited on the Cahill surface after an extensive period of erosion which removed most of the Upper Cahill and Nourlangie Formations. Eventually, minor structural activity, and erosion of the Kombolgie Sandstone, resulted in another epoch of remobilization of the uranium which was re-precipitated in the favorable traps of the Lower Cahill Formation about 900 to 500 m.y. ago. According to this theory, the uranium mineralization is epigenetic.

A second theory of origin suggests that uranium mineralization is syngenetic, i.e., the uranium was deposited contemporaneously with deposition of Lower Proterozoic rocks. It was subsequently remobilized and reconcentrated by hydrothermal ac-

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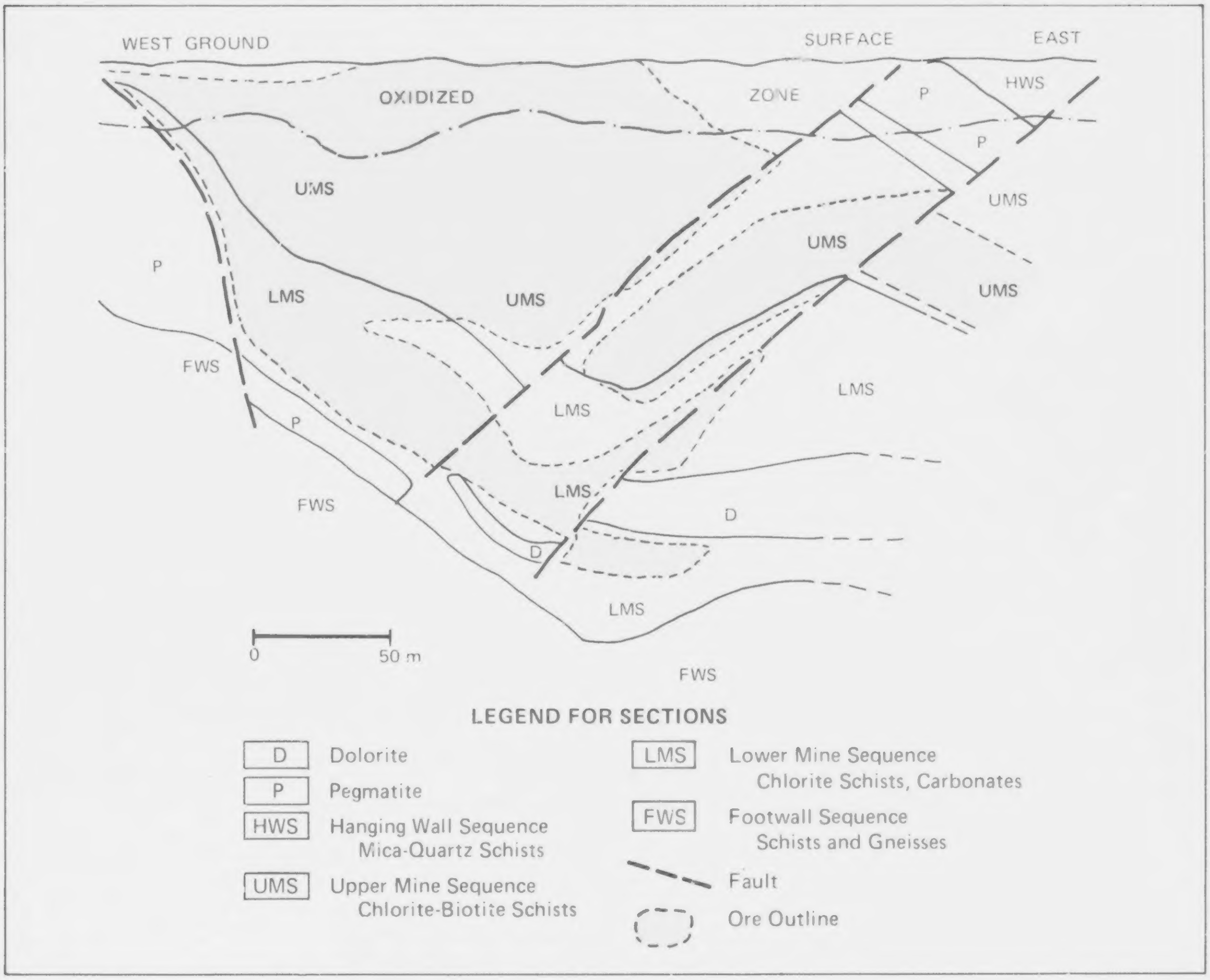
WEST GROUND
SURFACE
EAST
OXIDIZED
ZONE
HWS
P
UMS
LMS
FWS
D
0
50 m
LEGEND FOR SECTIONS
D Dolorite
P Pegmatite
HWS Hanging Wall Sequence Mica-Quartz Schists
UMS Upper Mine Sequence Chlorite-Biotite Schists
LMS Lower Mine Sequence Chlorite Schists, Carbonates
FWS Footwall Sequence Schists and Gneisses
Fault
Ore Outline

Figure 4
GENERALIZED GEOLOGIC SECTION THROUGH NO. 1 OREBODY

tivity associated with structural and metamorphic events about 1,800 m.y. Residual uranium in Archean rocks and the Lower Mine Sequence may have experienced a second phase of remobilization about 900 to 500 m.y. ago to complete formation of the deposits as they are known today.

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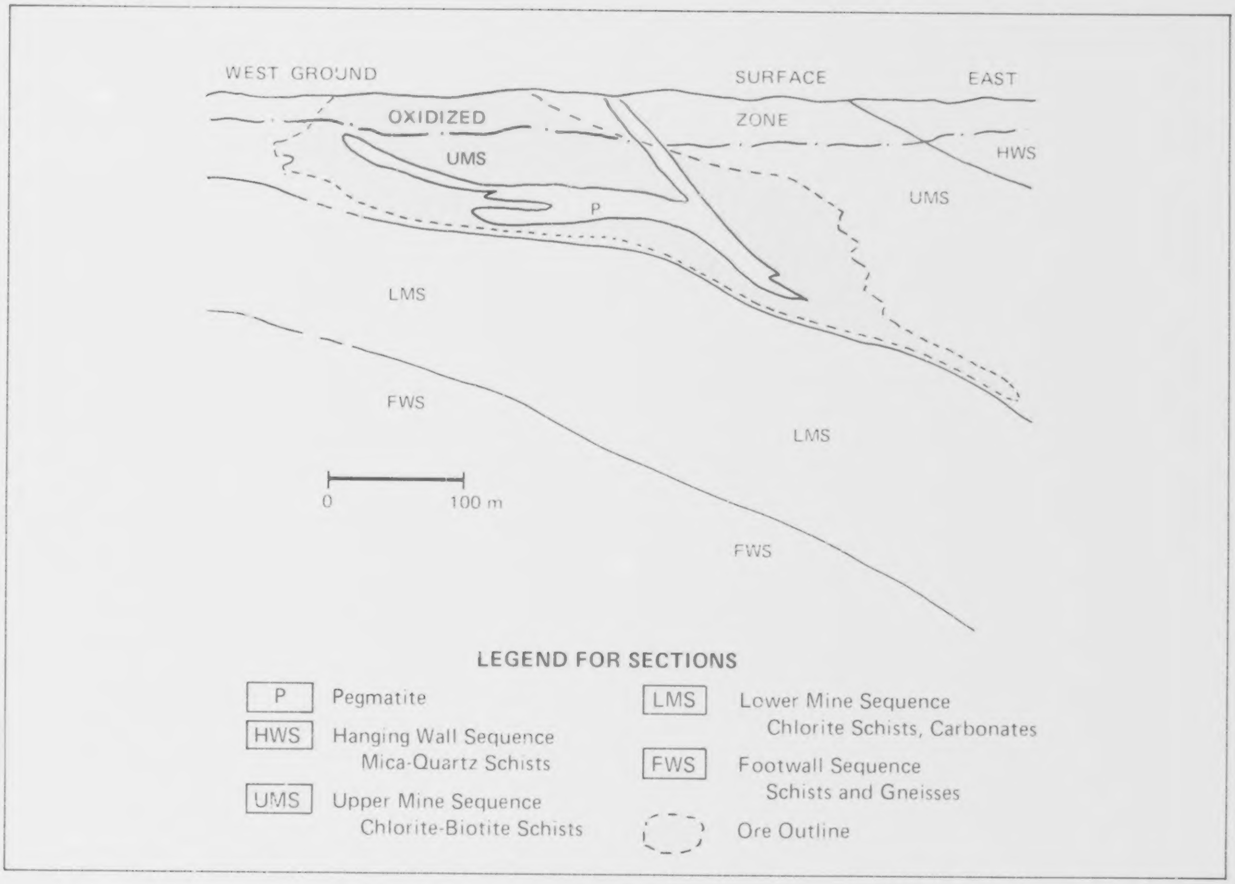
WEST GROUND
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ZONE
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LMS
FWS
LMS
0
100 m
FWS
LEGEND FOR SECTIONS
P Pegmatite
HWS Hanging Wall Sequence Mica-Quartz Schists
UMS Upper Mine Sequence Chlorite-Biotite Schists
LMS Lower Mine Sequence Chlorite Schists, Carbonates
FWS Footwall Sequence Schists and Gneisses
Ore Outline

Figure 5
GENERALIZED GEOLOGIC SECTION THROUGH NO. 3 OREBODY

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STATISTICAL DATA

EXCHANGE VALUE--$28.00 lb U_3O_8
Determined as of October 31, 1980

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of October 31, 1980

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
29.00	3.2	14	3

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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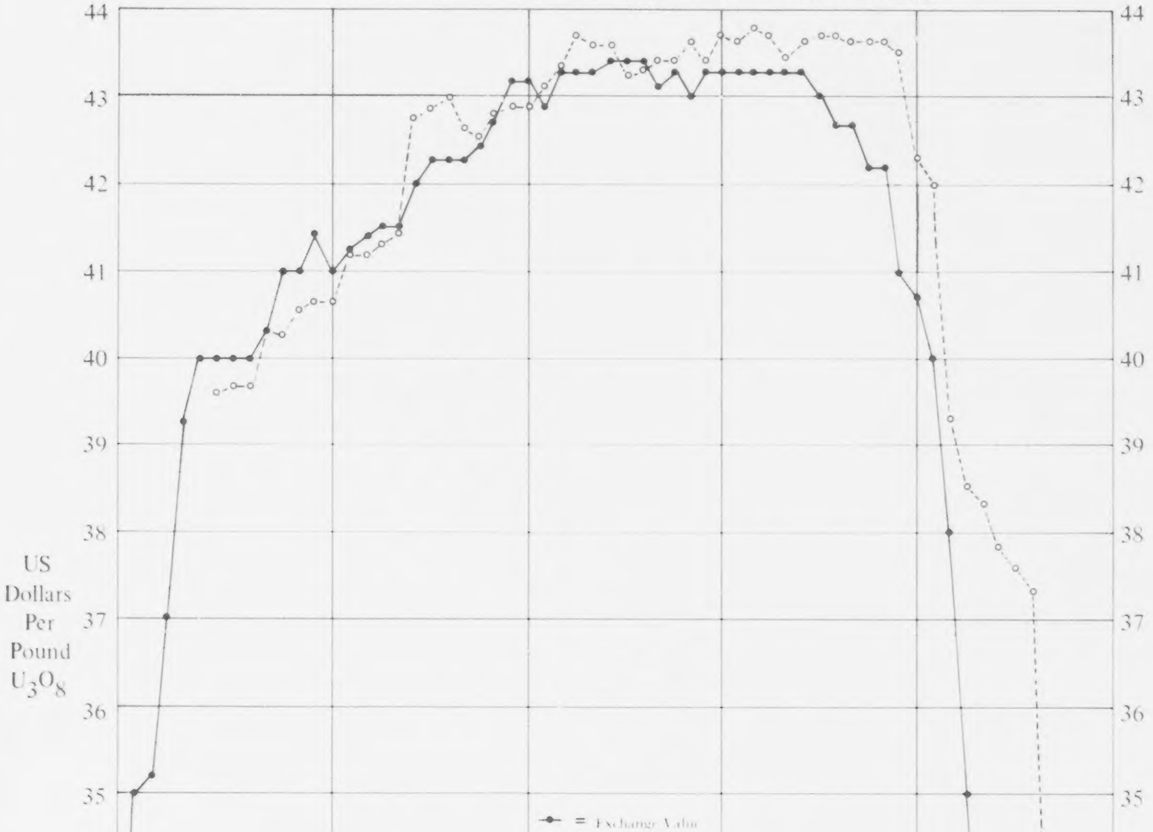
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE NOVEMBER 1975

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated

(US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00		

Note: See earlier Nuexco Reports for evolution of the definition of Exchange Value.

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated

(US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00		

Note: See Nuexco Report 135 for a discussion of the definition of Transaction Value.

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STATISTICAL DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	28.00	61.73	72.79
France (franc)	123.08	271.34	319.97
FRG (mark)	53.17	117.22	138.23
Japan (yen)	5,897	13,001	15,331
Switzerland (franc)	47.99	105.81	124.77
UK (pound)	11.46	25.27	29.80
Australia (dollar)	23.85	52.59	62.02
Canada (dollar)	32.97	72.68	85.71
Niger, Gabon (CFA)	6,154	13,567	15,999
South Africa (rand)	20.93	46.15	54.43

*Calculated using currency exchange rates published in the Wall Street Journal on the last Friday of the month.

LOAN USE CHARGE RATE—7.0% year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.
B. Rates included in *firm* proposals to borrow or lend.
C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
1238	81	101 – 300	104	US	US	
1240	82-96	2000 – 4000	–	Australia	Europe	Definitive price information not available.
1266	80	0 – 50	101	US	US	
1267	80	101 – 300	100	Europe	Europe	
1269	81	601 – 1000	98	US	US	UF_6

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*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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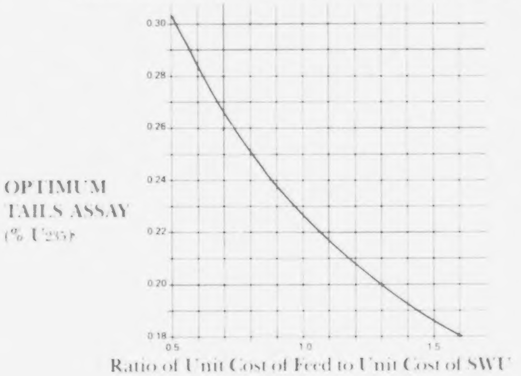
OPTIMUM TAILS ASSAY

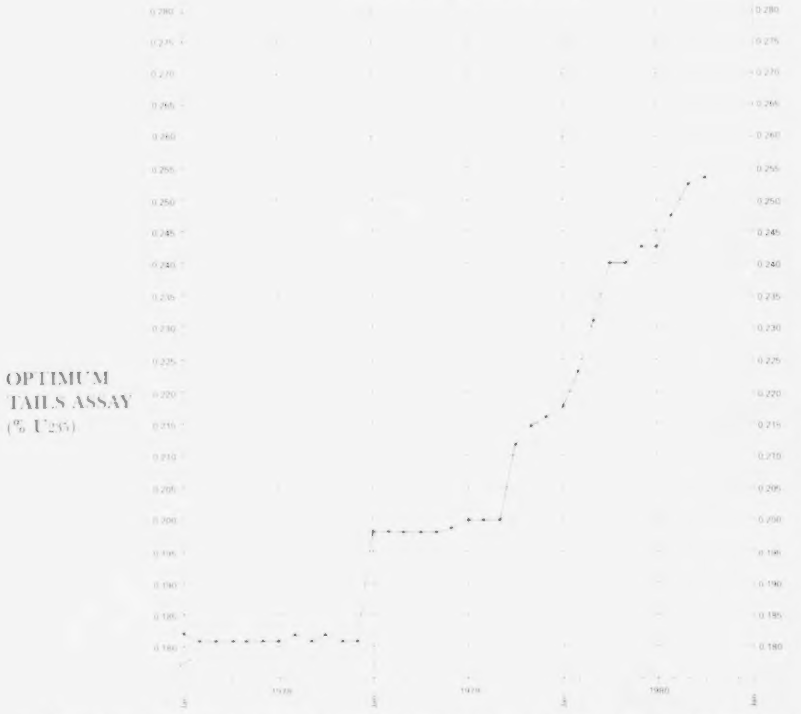
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]		
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970 (5)	110.0	116.3	91.36	3.88	3.87	3.69
Annual Avg. 1971 (5)	114.1	121.3	96.02	4.12	4.15	3.97
Annual Avg. 1972 (5)	117.9	125.3	100.00	4.56	4.59	4.26
Annual Avg. 1973 (5)	125.9	133.1	105.80	4.84	4.98	4.51
Annual Avg. 1974 (5)	153.8	147.7	116.02	5.44	5.63	4.88
Annual Avg. 1975 (5)	171.5	161.2	127.15	6.13	6.24	5.39
Annual Avg. 1976 (5)	182.4	170.5	133.71	6.76	6.87	5.91
Annual Avg. 1977 (6)	195.1	181.5	141.70	7.28	7.67	6.43
Annual Avg. 1978 (6)	209.4	195.4	152.05	8.23	8.56	7.02R
Annual Avg. 1979 (6)	236.5	217.4	165.46	9.27	9.49R	7.60R
Jul 1979	237.5	218.9	—	9.33R	9.57	7.61R
Aug 1979	240.6	221.1	—	9.38	9.70	7.66R
Sep 1979	244.2	223.4	167.20	9.63	9.79	7.74R
Oct 1979	249.0	225.4	—	9.67	9.87	7.83R
Nov 1979	250.6	227.5		9.78R	9.85R	7.88R
Dec 1979	253.1	229.9	170.58	9.80	9.92	7.92R
Jan 1980	260.6	233.2	—	9.91R	10.06	7.97R
Feb 1980	265.9	236.4	—	9.92R	10.01	8.01R
Mar 1980	268.6R	239.8	174.48	9.90R	10.22R	8.05R
Apr 1980	270.7	242.5	—	10.00	10.30	8.12
May 1980	271.2	239.8	—	10.18	10.37	8.17
Jun 1980	273.0	247.6	178.93	10.13	10.69	8.24
Jul 1980	275.6	247.8	—	10.24	10.82	8.35
Aug 1980	277.3P	249.4	—	10.28P	10.78P	8.38P
Sep 1980	278.2P	251.7	182.92	—	—	8.48P

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the march 1979 benchmark.

(5) Data for 1970-1976, monthly except for the GNP Implicit Price Deflator, and Price Index data for 1977-1978 appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Employment and Earnings data for 1977-1979, monthly, appear earlier in this Report.

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US GOVERNMENT STATISTICS

(Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$))[1]

Metal Mining (SIC 10)

	1977	1978	1979
January	6.95	7.73	8.71
February	7.02	7.79	8.81
March	7.07	7.84	8.85
April	7.12	7.97	9.04
May	7.19	8.04	9.06
June	7.26	8.08	9.09
July	7.32	8.25	9.33
August	7.37	8.40	9.38
September	7.49	8.56	9.63
October	7.52	8.60	9.67
November	7.63	8.71	9.78
December	7.65	8.72	9.80
Annual Average	**7.28**	**8.23**	**9.27**

Primary Non-ferrous Metals (SIC 333)

	1977	1978	1979
January	7.16	8.24	9.00
February	7.20	8.28	9.01
March	7.24	8.27	9.11
April	7.34	8.32	9.48
May	7.37	8.36	9.14
June	7.71	8.56	9.43
July	7.83	8.62	9.57
August	7.78	8.66	9.70
September	8.01	8.74	9.79
October	8.07	8.83	9.87
November	8.12	8.86	9.85
December	8.15	8.97	9.92
Annual Average	**7.67**	**8.56**	**9.49**

(Chemicals and Allied Products (SIC 28))

	1977	1978	1979
January	6.19	6.78	7.33
February	6.20	6.82	7.33
March	6.23	6.84	7.37
April	6.30	6.87	7.52
May	6.33	6.94	7.48
June	6.39	6.97	7.54
July	6.47	7.05	7.61
August	6.49	7.06	7.66
September	6.57	7.14	7.74
October	6.62	7.20	7.83
November	6.66	7.23	7.88
December	6.73	7.29	7.92
Annual Average	**6.43**	**7.02**	**7.60**

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(1) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings Supplement, Revised Establishment Data, September 1980."

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AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	215.4	190.04
Annual Avg. 1979	248.5	196.34
May 1979	288.5	193.55
Jun 1979	294.9	196.65R
Jul 1979	298.2	199.22R
Aug 1979	293.2	200.29R
Sep 1979	302.4	201.07R
Oct 1979	309.4	200.53R
Nov 1979	310.4	199.87R
Dec 1979	319.4	200.68R
Jan 1980	340.1	215.67R
Feb 1980	345.6	215.13R
Mar 1980	340.3	214.76R
Apr 1980	327.9	215.06R
May 1980	335.1	214.66R
Jun 1980	338.4	213.99R
Jul 1980	349.1P	221.26P
Aug 1980	353.2P	—

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra: "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Jun 1979	216.0	9.49	7.27	7.66
Jul 1979	218.3	9.37	7.34	7.73
Aug 1979	220.0	9.56	7.38	7.77
Sep 1979	223.4	9.75	7.50	7.81
Oct 1979	227.4	9.89	7.54	7.88
Nov 1979	228.1	9.97	7.61	7.91
Dec 1979	230.4	9.93	7.51	7.89
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.3R	10.50	8.01	8.44
Jun 1980	243.6R	10.33P	8.07P	8.46P
Jul 1980	246.0	10.45P	8.10P	8.53P
Aug 1980	248.6P	—	—	—

P = Preliminary R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 1.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 1.11 of Nuexco Report 138.

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REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)
Annual Avg. 1970 (3)	7.34	100.3 (4)
Annual Avg. 1971 (3)	7.88	106.4 (4)
Annual Avg. 1972 (3)	8.79	113.3 (4)
Annual Avg. 1973 (3)	10.51	124.1 (4)
Annual Avg. 1974 (3)	13.18	138.5 (4)
Annual Avg. 1975 (3)	16.71	157.2 (4)
Annual Avg. 1976 (3)	19.30	174.7 (4)
Annual Avg. 1977 (3)	23.87	194.4 (4)
Annual Avg. 1978 (3)	27.14	137.2
Annual Avg. 1979 (3)	30.18	155.3
Jul 1979	–	157.9
Aug 1979	–	160.2
Sep 1979	30.71	162.1
Oct 1979	–	162.9
Nov 1979	–	163.4
Dec 1979	31.89	164.0
Jan 1980	–	165.4
Feb 1980	–	167.0
Mar 1980	33.65	168.0
Apr 1980	–	170.0
May 1980	–	171.9
Jun 1980	34.08	174.6
Jul 1980	–	177.2
Aug 1980	–	179.2
Sep 1980	–	182.8

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(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.

(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."

(3) Historical data for 1970 through 1979 appear on page 4.9 of Nuexco Report 140.

(4) April 1970 = 100.00

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1286	150	150	150	Long term
1392	200			
1394	1000			UF_6
1475	1000			UF_6
1480	500			
1481	250			
1490	1250			
1496	300			
1533	400			UF_6
1539	200			
1540	750			UF_6
1547	100			
1550	1000			UF_6
1551	150			
1552	200			
TOTALS	7450	150	150	
Available for Loan:				
1355	600			
1429	500			
1492	900			UF_6
1520	1000			UF_6
1531	500			UF_6
TOTAL	3500			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1408	150			
1459		200	200	Long term
1462			100	Long term
1488	100			
1489	200			
1497	500			
1508	150			
1529			550	Long term
TOTALS	1100	200	850	
Inquiries to Borrow:				
1553	900			
TOTAL	900			

*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1394	850			
1424	850			
1450	850			
1451	150			
1475	850			
1533	350			
1540	650			
TOTAL	4550			

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	

*Measured from the date of this Report.

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Erratum

Table 6 of Report 147 (November, 1980) contained a systematic error. A corrected version of Table 6 is printed below.

Table 6

NUCLEAR GENERATION CAPACITY FORECAST FOR 1990

(thousands of megawatts)

	EIA[1] (Low-High)	Nuexco
OECD Countries		
Australia New Zealand	-0-	-0-
Austria Switzerland	2.9-2.9	4.9
Benelux Denmark	6.0-6.0	5.9
Canada	13.4-14.2	13.6
France	38.5-44.2	48.2
Germany	22.5-27.5	22.5
Greece Turkey	-0-	0.6
Italy	3.4-4.3	4.3
Japan	24.5-30.9	29.9
Scandinavia	12.6	11.6[2]
Spain Portugal	9.3-13.2	11.4
United Kingdom Ireland	11.6-13.4	10.9
Subtotal	145-170	164
United States	121-139	112
Non-OECD Countries		
Argentina	1.5-2.4	0.9
Brazil	1.9-3.4	3.1
India	1.9-2.4	1.7
South Korea	5.5-7.4	7.2
Mexico	1.3-2.6	1.3
Pakistan	0.1-0.7	0.1
Philippines	0.6-0.6	0.6
South Africa	1.8-2.7	1.8
Taiwan	4.9-6.7	4.9
Yugoslavia	0.6-1.2	0.6
Subtotal	20-30	22
TOTAL	286-339	298

[1] Source: 1979 Annual Report to Congress, Energy Information Administration, Volume 3, pages 31 and 108.

[2] Includes, for purposes of comparison, two reactors fueled by the USSR.

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NUEXCO

SPECIAL REPORT **NOVEMBER 1980**

[redacted]

12/22/80 B 6800-1 U -

World Uranium Resources

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World Uranium Resources

by

T. A. Boyden
Vice President
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NUEXCO

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NUEXCO

World Uranium Resources

INTRODUCTION

Uranium exploration and development activities have been reviewed by Nuexco with the primary objective of establishing an estimate of uranium resources currently available in the Free World. Nuexco estimates are based on *reasonably assured resources*, which are defined as known quantities of uranium that can be recovered within a given cost range, based upon current mining and milling technology. The cost cutoff used throughout this report is US$50.00 or less per pound U_3O_8.

The definition is broad enough to include all resource estimates based on various geologic, technologic and economic parameters. More importantly, it is consistent with the terminology applied to world resources by the International Atomic Energy Agency (IAEA). It is also equivalent to the term *ore reserves* as reported by the US Department of Energy (USDOE).

The IAEA refers to *estimated additional resources* as all undiscovered uranium expected to occur along well-defined geologic trends containing known deposits, and considered recoverable within the given cost range. Estimated additional resources have not been considered in this report.

The Nuexco estimate of reasonably assured resources, as of November 1, 1980, totals 2,800,000 tonnes U_3O_8, compared to an estimate of 2,590,000 tonnes on June 15, 1979. This represents an increase in reasonably assured resources of 210,000 tonnes U_3O_8[1] above Nuexco's June 15, 1979 estimate.

Most of the increase occurred in South Africa where uranium resources are related to gold reserves in the Witwatersrand district. A significant downward adjustment in Canadian resources was made to correspond with measured and indicated resources calculated by the Canadian Department of Energy, Mines and Resources.

Exploration and development activities have declined in some areas, especially in the US and Niger. The Australian uranium industry is moving ahead with the development of the Nabarlek and Ranger deposits in the Northern Territory. In Canada, exploration is at about the same level as 1979. New projects are limited primarily to northern Saskatchewan.

Activities in other countries are highlighted by the announced discovery of 23,600 tonnes U_3O_8 in France, where an aggressive exploration and development program is on-going. Details on activities in other countries are less well known, although discoveries have been reported in Turkey, Austria and Finland.

AFRICA

Interest in African uranium has led to exploration activities throughout the continent. Known deposits and minor occurrences are found in South Africa, Namibia, Niger, Gabon, Central African Empire, Algeria, Nigeria, Zambia, Somalia and Egypt. Exploration projects are currently under way in Zimbabwe, Mauritania, Mali, Libya, Chad, Zaire, Angola, Tanzania and Kenya. Reasonably assured resources for Africa are approximately 858,500 tonnes U_3O_8. The principal areas of interest are shown in Figure 1.

South Africa

The bulk of South Africa's uranium is produced as a by-product to gold production. Uranium production levels in South Africa are therefore not as sensitive to price as in other uranium producing nations. Uranium production is, in fact, affected more by fluctuations in gold value than uranium value. Reasonably assured resources, as limited to the quartz-pebble conglomerates of the Witwatersrand system, are estimated by the South African Atomic Energy Board at 364,000 tonnes U_3O_8, plus approximately 45,000 tonnes U_3O_8 in mill tailings. Reasonably assured resources known to occur in other rock types are limited to 40,000 tonnes U_3O_8 in sediments of the Karoo Basin, and 3,000 tonnes in the carbonates at Palaborwa. Reasonably assured resources total 452,000 tonnes U_3O_8.

Production capacity is about 13,000 tonnes U_3O_8 per year from 12 uranium production centers in the Witwatersrand district of South Africa, nine of which recover uranium as a by-product of gold mining. The remaining three produce gold and uranium as co-products, i.e. both are necessary for viability. Three additional production centers are under construction —all of which will recover uranium. Uranium is also produced as a byproduct at the Palaborwa copper mines in the northeast region of South Africa.

Uranium production centers in the Witwatersrand district of the Republic of South Africa are listed in Table 1.

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[1] The reserve increase of 210,000 tonnes U_3O_8 is a gross amount. 1979 production has not been considered.

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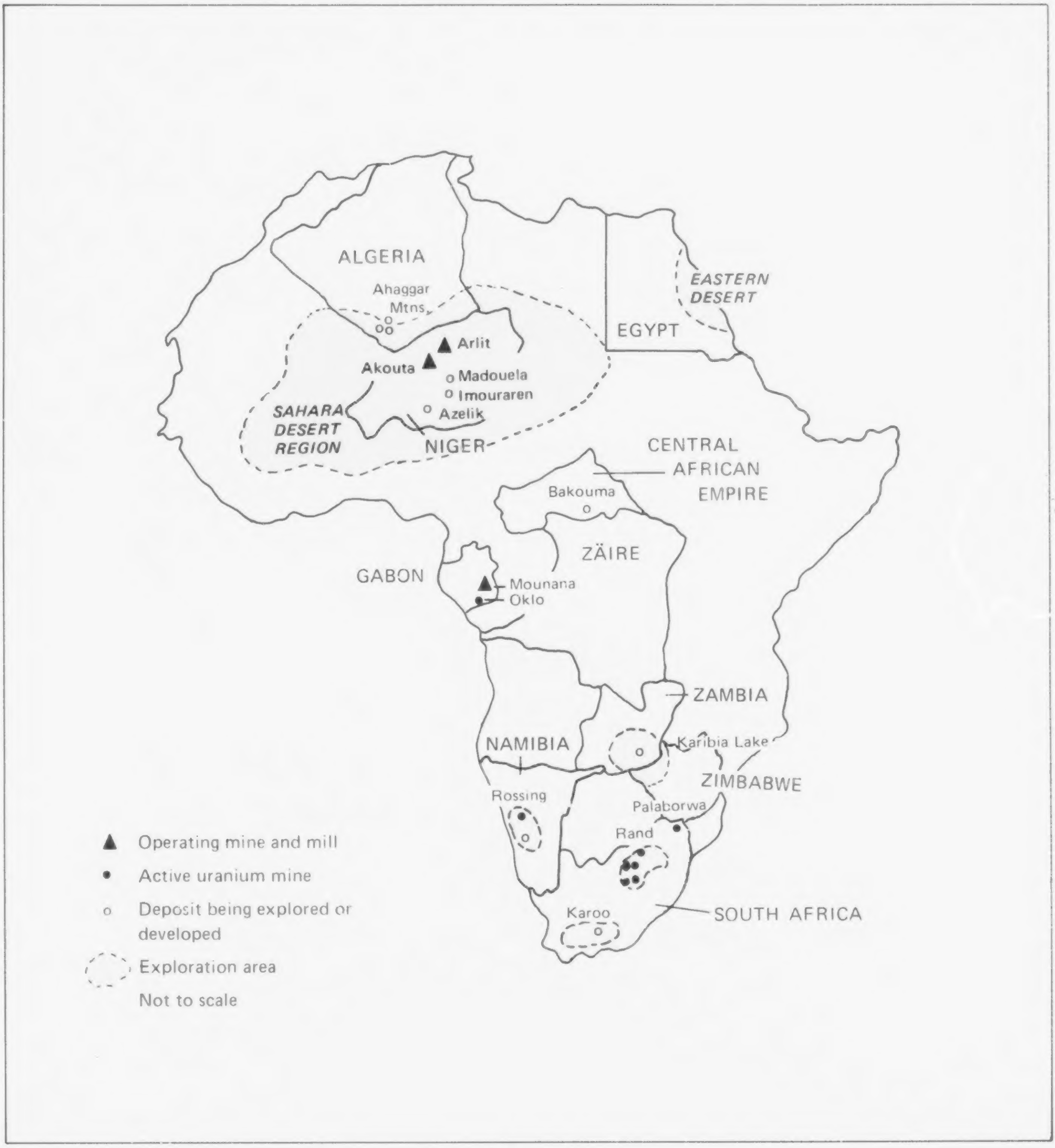
ALGERIA
Ahaggar Mtns.
Arlit
Akouta
Madouela
Imouraren
Azelik
SAHARA DESERT REGION
NIGER
EGYPT
EASTERN DESERT
CENTRAL AFRICAN EMPIRE
Bakouma
ZÄIRE
GABON
Mounana
Oklo
ZAMBIA
NAMIBIA
Karibia Lake
ZIMBABWE
Rossing
Palaborwa
Rand
Karoo
SOUTH AFRICA
▲ Operating mine and mill
● Active uranium mine
○ Deposit being explored or developed
Exploration area
Not to scale

Figure 1
AFRICA

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Table 1

URANIUM PRODUCTION CENTERS OF THE WITWATERSRAND DISTRICT, SOUTH AFRICA

Operating

Randfontein
West Driefontein
Western Deep Levels
Blyvooruitzicht
Chemwes (Stilfontein)
Hartebeestfontein
Buffelsfontein
Vaal Reefs
Joint Metallurgical Scheme
Harmony[2]
West Rand Consolidated[2]
Ergo[2]

Under Construction:

Western Areas
Afrikander Lease[2]
Beisa[2]

---

[2] Gold and uranium ore co-products.

Namibia

Exploration and mining activity in Namibia is centered around the Rossing deposit. Mine and mill production is about 5,000 tonnes per year of U_3O_8. Evaluation of the country's other uranium deposits, particularly the Langer Heinrich deposit, is still in progress, but at a reduced level of activity. Reasonably assured resources are estimated at 90,000 tonnes U_3O_8 at the Rossing deposit and about 11,000 tonnes U_3O_8 at the Langer Heinrich deposit.

Niger

The Agadez basin area of Niger has emerged as one of the world's main sources of uranium. The level of exploration has decreased, but production capacity is increasing. Production in 1979 was 4,175 tonnes U_3O_8. Expanded production capacity is under construction. Total capacity in Niger could reach 5,300 tonnes U_3O_8 by 1982 or 1983.

The Arlit deposit, controlled by Societe des Mines de l'Aire (Somair), was the first to be mined in Niger. The ore deposit is in Carboniferous clay and sandstone formations. The average grade of the ore is 0.21 percent U_3O_8.[3] Annual mine and mill production rate is 2,100 tonnes U_3O_8. Production capacity is scheduled to be increased to 2,700 tonnes U_3O_8 by 1982 or 1983. Reasonably assured resources total about 25,000 tonnes U_3O_8.

The Akouta deposit, controlled by Compagnie Miniere d'Akouta (Cominak), began production in 1978. Reasonably assured resources at Akouta are estimated at 17,000 tonnes U_3O_8. Production in 1979 was 2,075 tonnes U_3O_8. Production capacity is planned to be increased to 2,600 tonnes U_3O_8 by 1982. The deposit occurs in the same Carboniferous formation as at Arlit.

The largest deposit in Niger is the Imouraren deposit located about 70 km south of Akouta. The Office National des Ressources Miniere, a government agency known as Onarem, reports that the orebody contains reasonably assured resources of approximately 78,000 tonnes U_3O_8, at an average grade of 0.12 percent U_3O_8. The ore zone occurs in Jurassic sandstones. Three other deposits in the same geologic environment as the Arlit and Akouta deposits are being considered for development: the Arni deposit is in the final engineering stage; the Azelik and the Madouela deposits are in the final evaluation and feasibility stages.

Reasonably assured resources in the Republic of Niger are estimated by Onarem to total 150,000 tonnes U_3O_8 in the deposits of Arlit, Akouta and Imouraren, plus approximately 15,000 tonnes U_3O_8 contained in other known deposits.

Gabon

Exploration in Gabon is at a low level and confined primarily to the district containing the Oklo and Mounana deposits. Reasonably assured resources in those two deposits are approximately 21,000 tonnes U_3O_8. Both deposits are being produced at a combined rate of 1,300 tonnes U_3O_8 annually.

Other Africa Israel

Reasonably assured resources in the Central African Empire and Algeria remain unchanged at 9,500 and 33,000 tonnes U_3O_8 respectively. The larger deposits in southern Algeria are being evaluated for mining. The Egyptian Nuclear Materials Authority recently announced the discovery of about 5,000 tonnes U_3O_8

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[3] Ore grade refers to the relative quantity or percentage of uranium content of the ore.

near Qina, on the Red Sea coast. Details on the deposit are not available. Anomalous radioactive occurrences along the Zimbabwe-Zambia border are being evaluated by Anglo-American Corporation of South Africa.

Israel has reasonably assured resources of about 36,000 tonnes U_3O_8 associated with phosphate deposits in the Dead Sea and in the Negev Desert. The uranium would be produced as a by-product of phosphoric acid production. However, there are no plans to develop the phosphate deposits in the immediate future.

ASIA

Uranium exploration and development has increased substantially throughout the Far East in the last ten years. Active exploration areas include China, Japan, Korea, Thailand, India and Pakistan. Areas of primary interest are shown in Figure 2.

China

China's interest in uranium has increased recently. Uranium occurrences have been reported in Xinjiang Uygur, Qinghai, Inner Mongolia, Liaoning, Guizhou and Guangdong provinces. Only limited information is available on uranium exploration and development activities in China. The following is taken generally from published information and through direct communication with Chinese representatives.

The Chinese report a major uranium occurrence in south China. The deposit was originally discovered in 1956, but only recently reported. The orebody is described as covering about 100 square kilometers containing over 100 rich veins of easily extracted uranium in granite strata. This implies that the deposit may be similar to the deposits in the Forez and Vendee areas of France.

Additional mineralization was discovered in northeast China in 1978. The area is reported to have a geologic setting similar to the east Alligator River region of Australia's Northern Territory. The potential of the area is being evaluated for additional uranium occurrences.

The Lianshanguan deposit, in the Liaoning province of northeast China, has potential resources of about 900 tonnes U_3O_8. The deposit is localized in quartzite and has an average grade of about 0.5 percent U_3O_8. The principal uranium mineral present is pitchblende. The Chinese report that the deposit has not been studied in detail.

The Saima deposit is located in Inner Mongolia. Mineralization has been discovered in alkaline rock, the outcrop area of which measures about 20 square kilometers on the surface. Preliminary drilling indicates that mineralization may extend to a depth of 1,000 meters. Additional evaluation will be required prior to exploiting the deposit.

Of interest also, is the fact that the Chinese say they have discovered a new secondary uranium mineral in Western Hunan province. The new mineral was named Furongite and its composition is $Al_2UO_2(PO_4)_2 \bullet 8H_2O$). The new mineral was discovered in 1974 in Lower Cambrian Carbonaceous shale. It is bright yellow in color and occurs as veinlets or irregular masses along fracture surfaces. Furongite has been found in other uranium deposits as well, usually in association with autunite.

Japan

Reasonably assured resources in Japan are about 8,200 tonnes U_3O_8. Prospecting continues in Tono, the area believed to carry the greatest potential for uranium deposits in Japan. Japan has one milling plant with a capacity of 30 tonnes U_3O_8 per year. There are no plans to construct additional commercial milling plants.

India

India has reasonably assured resources of about 18,000 tonnes U_3O_8 located primarily at the Jaduguda mine in Bihar province. The deposit was first mined in 1956. Production from the mine is 1,000 tonnes of ore per day, all of which is processed at a nearby mill. Additional ore deposits have been discovered in the crystalline rocks of the Madhya Pradesh and Rajasthan provinces of central India.

AUSTRALIA

Two political decisions made in Australia during 1979 were significant to the country's developing uranium program. First, the federal government licensed the mining and milling of the Nabarlek deposit (milling began in May 1980), and initial strip mining and mill construction was started on the Ranger One deposit. Second, the new Premier of South Australia announced that production of uranium would be permitted, after a moratorium extending over the past seven years. Areas of primary interest in Australia are shown in Figure 3.

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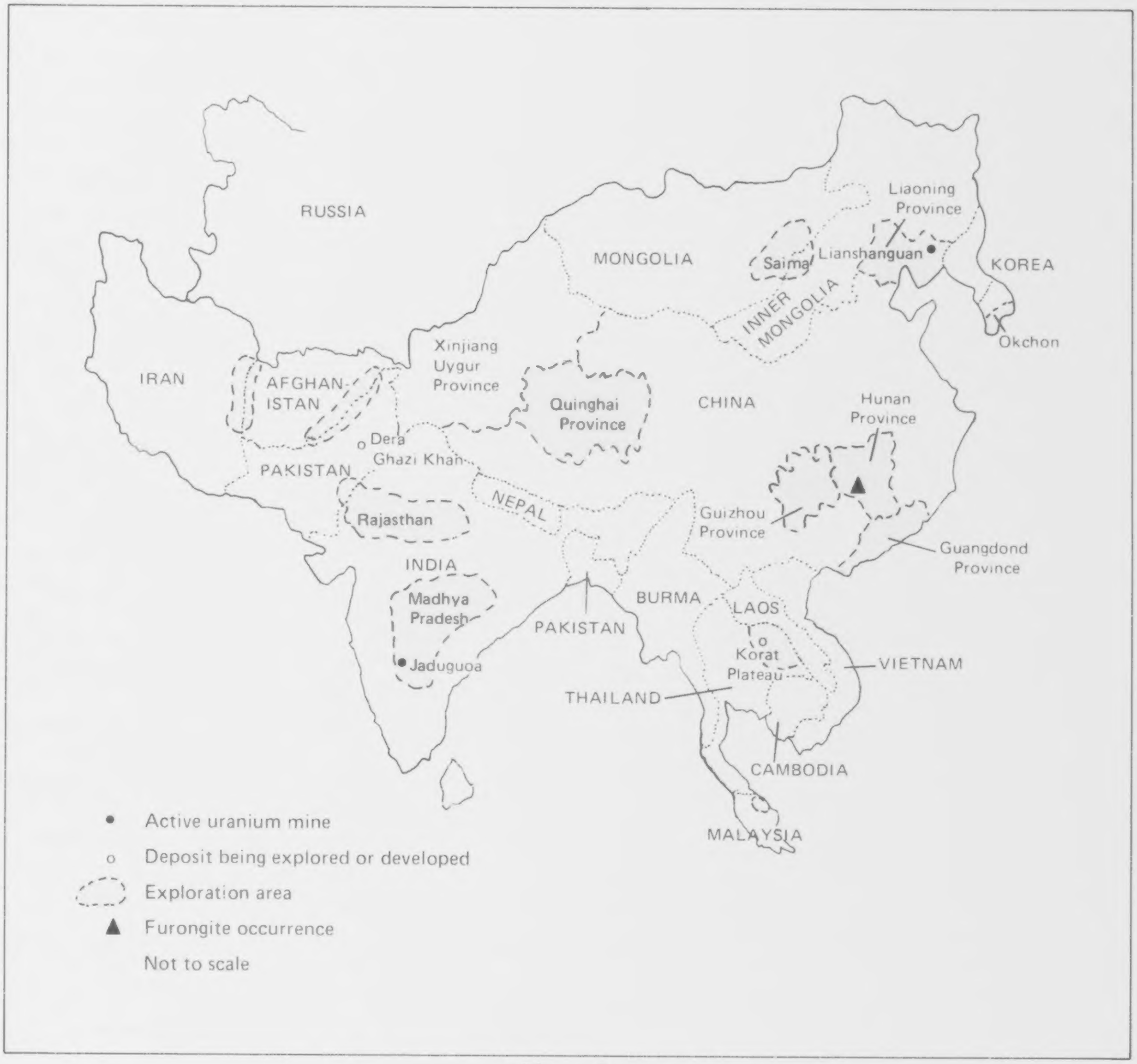
RUSSIA
MONGOLIA
Liaoning Province
Saima
Lianshanguan
KOREA
INNER MONGOLIA
Okchon
Xinjiang Uygur Province
IRAN
AFGHAN-ISTAN
Quinghai Province
CHINA
Hunan Province
Dera Ghazi Khan
PAKISTAN
NEPAL
Rajasthan
Guizhou Province
Guangdond Province
INDIA
BURMA
LAOS
Madhya Pradesh
PAKISTAN
Korat Plateau
VIETNAM
Jaduguoa
THAILAND
CAMBODIA
MALAYSIA
● Active uranium mine
○ Deposit being explored or developed
Exploration area
▲ Furongite occurrence
Not to scale

Figure 2
ASIA

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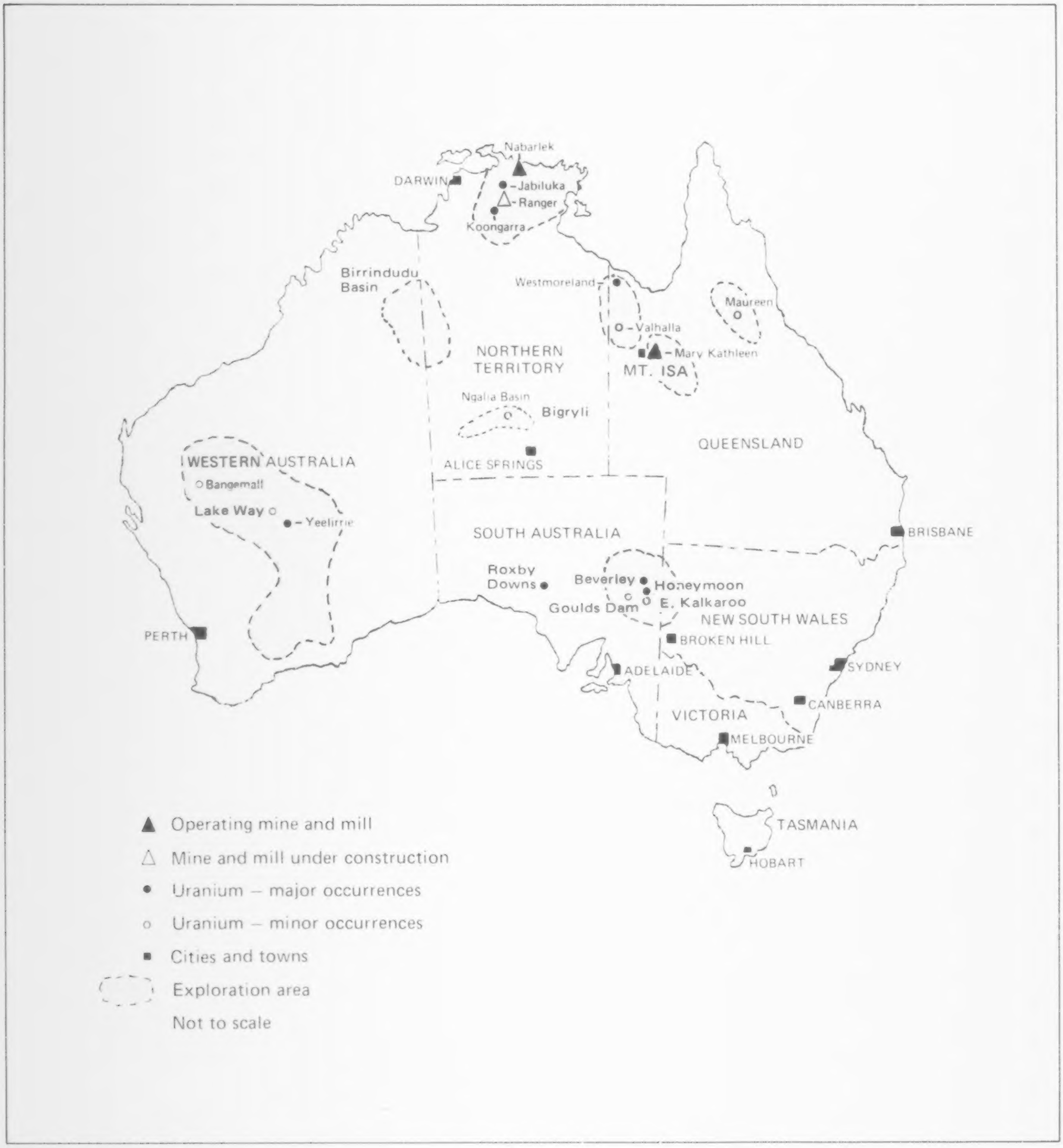
Nabarlek
DARWIN
Jabiluka
Ranger
Koongarra
Birrindudu Basin
Westmoreland
Valhalla
Mary Kathleen
MT. ISA
Maureen
NORTHERN TERRITORY
Ngalia Basin
Bigryli
ALICE SPRINGS
QUEENSLAND
WESTERN AUSTRALIA
Bangemall
Lake Way
Yeelirrie
SOUTH AUSTRALIA
BRISBANE
Roxby Downs
Beverley
Honeymoon
Goulds Dam
E. Kalkaroo
NEW SOUTH WALES
PERTH
BROKEN HILL
SYDNEY
ADELAIDE
CANBERRA
VICTORIA
MELBOURNE
TASMANIA
HOBART
▲ Operating mine and mill
△ Mine and mill under construction
● Uranium – major occurrences
○ Uranium – minor occurrences
■ Cities and towns
Exploration area
Not to scale

Figure 3
AUSTRALIA

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Exploration is in progress throughout the area of the Pine Creek Geosyncline—the geologic structure containing the Koongarra, Ranger, Jabiluka and Nabarlek deposits in the Northern Territory, and in northwest Queensland in the region of the Westmoreland, Valhalla, Maureen and Mary Kathleen deposits. Activities in South Australia are directed toward further evaluation of deposits in the Lake Frome Embayment and the large copper uranium deposit at Roxby Downs. Preliminary in situ leach tests on the Honeymoon deposit at Lake Frome showed favorable recovery results. Further testing is now in progress to determine the feasibility of recovering the uranium by this method, rather than conventional methods.

The Yeelirrie deposit remains the largest uranium deposit known in Western Australia. The ore minerals occur in calcrete beds of Tertiary age. Project development is tentatively scheduled to begin in 1985. Evaluation of the Lake Way deposit (also referred to as Wiluna) is still in progress. Exploration has been renewed in the Birrindudu Basin area along the border of Western Australia and the Northern Territory, where the geologic environment is similar to that of the Pine Creek Geosyncline. The potential is favorable for large, high grade deposits in the Tanami Complex of Lower Proterozoic age.

Evaluation of the Mary Kathleen, Valhalla, Westmoreland and Maureen deposits in northern Queensland is also in progress. Exploration activity has spread to include surrounding areas, where new uranium occurrences have been discovered. Additional evaluation work remains to be done in most cases; however, at the Mary Kathleen mine, new recoverable reserves have been included in the mine plan. The Mary Kathleen mine remains as the only operating uranium mine in Queensland.

Reasonably assured resources in Australia are estimated from published information at 465,200 tonnes U_3O_8. Australian resources make up about 20 percent of the world's known reasonably assured resources. Table 2 is a breakdown of Australian resources by state.

Table 2

AUSTRALIAN URANIUM DEPOSITS REASONABLY ASSURED RESOURCES BY STATE

State Deposit	Tonnes U_3O_8	% Ore Grade	Remarks
Northern Territory			
Nabarlek	12,000	2.36	Ore mined out, mill operating
Jabiluka	208,000	0.39	Development feasibility study in progress
Ranger	111,000	0.30	Mine and mill under construction
Koongarra	30,000	0.34	Development feasibility study in progress
Bigryli	1,200	0.45	Evaluation Drilling
Queensland			
Mary Kathleen	6,000	0.11	Mine and mill operating
Valhalla	5,800	0.16	Evaluation Drilling
Westmoreland	14,500	0.17	Evaluation Drilling
Maureen	3,600	0.14	Evaluation Drilling
Western Australia			
Yeelirrie	46,300	0.15	Development feasibility study in progress
Lake Way	4,500	0.15	Development feasibility study in progress
South Australia			
Beverley	16,000	0.28	Considered for open pit and or in situ leaching
Honeymoon	3,400	0.22	In situ leach test pending
East Kalkaroo	1,100	0.15	Considered for in situ leaching
Goulds Dam	1,800	0.12	Considered for in situ leaching

Total Reasonably Assured Resources: 465,200 tonnes U_3O_8

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EUROPE

France, Spain, Portugal, Ireland, Sweden, Denmark, Italy and West Germany continue to maintain an aggressive role in the exploration for uranium resources. While much of their effort is directed toward the more favorable uranium provinces of Africa, Canada, Australia and the United States, some effort is being devoted to exploration within Europe, especially in France. Figure 1 shows the main areas of interest throughout Europe.

France

The French have assumed a leadership role in developing nuclear power, including a highly successful uranium exploration and development program. Other European countries have initiated domestic uranium programs as well, but in any case, results have been less successful than in France.

The exploration by Cogema (Compagnie Generale des Matieres Nucleaires) has resulted in another significant uranium discovery in France. Cogema recently announced the discovery of approximately 23,600 tonnes U_3O_8 in Tertiary sediments located near Contras, northeast of Bordeaux, in southwest France. Several ore deposits have been found in a roll-front environment in Eocene sediments similar to the deposits in Wyoming in the United States.

The average grade of the ore is 0.10 percent to 0.12 percent U_3O_8. The ore is shallow enough to be mined by open pit methods. The deposits occur in a broad Tertiary basin, representing a large area which is geologically favorable for additional ore occurrences. Cogema is continuing exploration of the basin area.

The new discovery increased reasonably assured resources in France to approximately 93,600 tonnes U_3O_8, up from 70,000 tonnes U_3O_8 last year. The Lodeve district of southeast France has resources of about 23,000 tonnes U_3O_8. The remaining 17,000 tonnes U_3O_8 are located in metamorphic and granitic rocks in the central Massif district of La Crouzille, Forez and Vendee. Exploration is also underway near Morvan and Vosges in northeast France.

Domestic uranium production was about 2,700 tonnes U_3O_8 in 1979. This could increase to 3,600 tonnes U_3O_8 during 1981 if present expansion programs are completed as scheduled. A timetable for development of the deposits at Contras has not been announced.

Spain

The output of uranium concentrates in Spain has levelled off at about 235 tonnes U_3O_8 per year. The main mine at Ciudad Rodrigo, in Salamanca, has an annual capacity of about 120 tonnes U_3O_8; approximately 85 tonnes U_3O_8 were produced from the Andujar mines, and 30 tonnes from the El Lobo mine.

Reasonably assured resources in spain equal about 12,500 tonnes U_3O_8. Of that amount, 11,000 tonnes occur in the Ciudad Rodrigo mine. Expansion now in progress at the Ciudad Rodrigo facility will increase annual capacity to 900 tonnes U_3O_8 by 1983.

Portugal

Portugal's reasonably assured resources are approximately 9,000 tonnes U_3O_8. The greatest geologic potential for uranium is in the vein deposits in the Hercynian granites and associated contact-metamorphic rocks. In 1979, Portugal produced 133 tonnes U_3O_8 from the Cunha Baixa, Urgeirica and Nisa mines, and at least three smaller deposits.

Sweden

The plan to recover uranium as the primary mineral from the Billingen shales, near Ranstad, has been abandoned according to an announcement by the Swedish government. However, the recovery of by-product uranium from the shales may be realized through a new plan to mine the shales for eight minerals in addition to uranium. Such a mining plan is under consideration through the joint venture effort of LKAB, the state-owned mining company, and Boliden, a large, privately owned mining company. The joint venture company ASA, is conducting research and development programs to determine the feasibility of the plan.

The only reasonably assured resources known in Sweden are located at Pleutajokk, in the northern part of the country. The deposit consists of uraninite mineralization occurring in veins and fractures associated with faulting in metavolcanics. Reasonably assured resources are about 1,200 tonnes U_3O_8. The deposit will be evaluated further before development is considered.

Primary uranium mineralization occurrences have been discovered in pegmatites and aplites throughout Sweden. None of the occurrences are considered to be exploitable; even so, the potential is high for the discovery of additional uranium resources in a number

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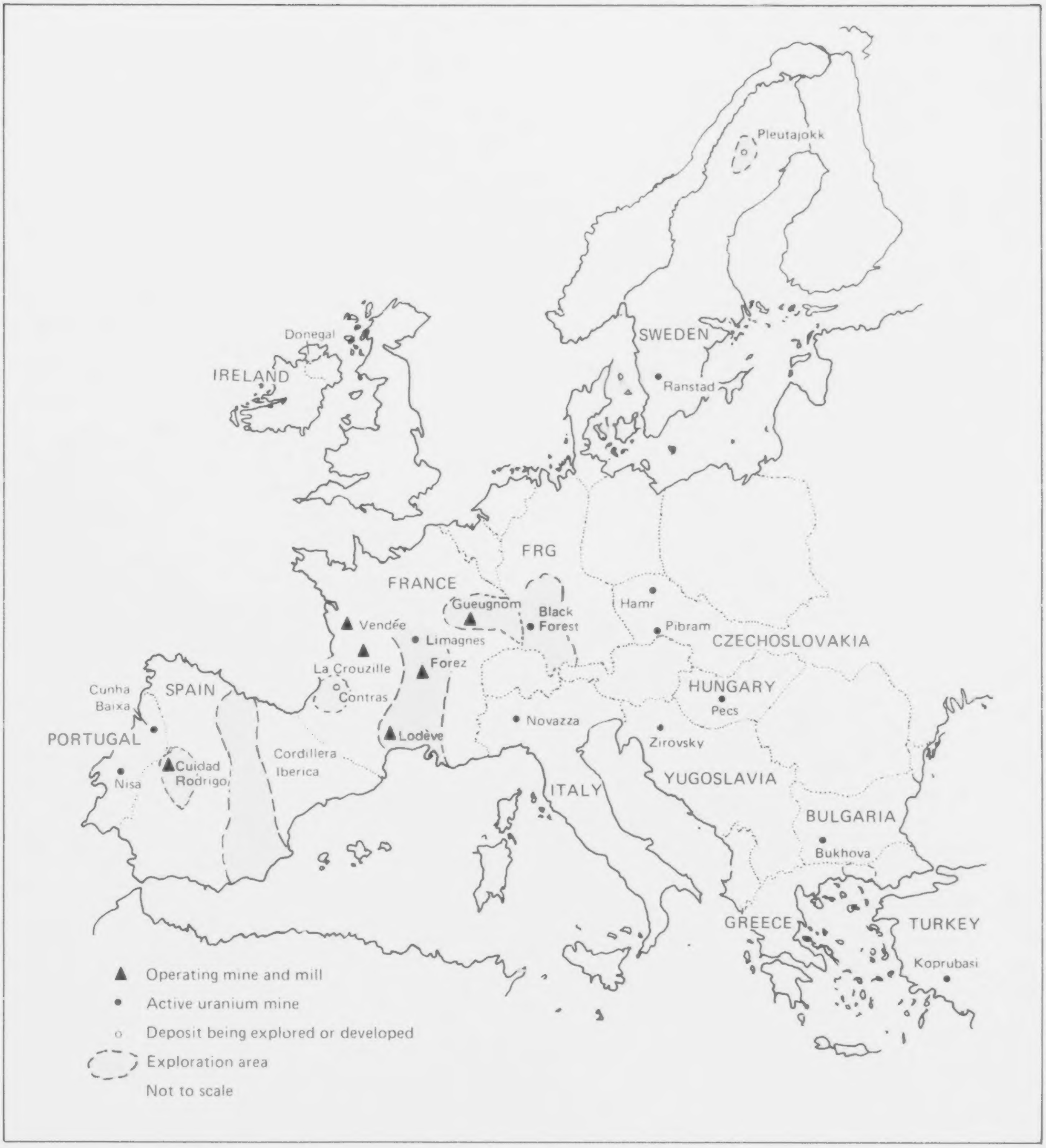
Pleutajokk
SWEDEN
Ranstad
Donegal
IRELAND
FRG
FRANCE
Gueugnom
Black Forest
Hamr
Pibram
CZECHOSLOVAKIA
Vendée
Limagnes
La Crouzille
Forez
Contras
Cunha Baixa
SPAIN
PORTUGAL
Nisa
Cuidad Rodrigo
Cordillera Iberica
Lodève
Novazza
HUNGARY
Pecs
Zirovsky
YUGOSLAVIA
ITALY
BULGARIA
Bukhova
GREECE
TURKEY
Koprubasi
▲ Operating mine and mill
● Active uranium mine
○ Deposit being explored or developed
Exploration area
Not to scale

Figure 4
EUROPE

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of different geologic environments throughout the country.

Denmark

All uranium resources controlled by Denmark are located in Greenland. Exploration activity in Greenland has increased due to the availability of additional financing from the Danish government and the Commission of European Communities (EEC). Uranium exploration efforts are concentrated in the southern area near Kvanefjeld, where a low grade deposit has been found. Reasonably assured resources are about 32,000 tonnes U_3O_8. The Geological Survey of Greenland continues to evaluate the country for additional uranium resources. Southern and eastern Greenland are considered the most favorable areas.

Italy

The Novazza deposit, in the Bergamo province of northwest Italy, is the only proven uranium deposit in Italy. Reasonably assured resources are about 1,200 tonnes U_3O_8 at an average grade of 0.09 percent U_3O_8. Minor occurrences of uranium have also been found at Val Rendena, Trento province, and in the Preit Valley, Cuneo province. Agip Nuclear is exploring in each area.

Greece

Exploration activities in northern Greece are concentrated near Drama and Kavalla in the region of Macedonia. Reasonably assured resources of about 1,000 tonnes U_3O_8 have been reported in this area by the Greek Atomic Energy Commission. In Serres, uranium has been discovered in lignite. Concentrations range from 0.015 percent to 0.025 percent U_3O_8 over an area of 1.0 by 1.5 kilometers.

Other Europe

Anglo United Development Corporation has found significant uranium mineralization at its Finn uranium project in County Donegal, Ireland. Contained uranium varies form a low of 0.01 percent to a high of 0.17 percent U_3O_8. Mineralization is found along a fault structure for a distance of about 2,300 feet. Evaluation of the project area is still in progress. Other companies are exploring in the same district, and in Kilkenny and Leinster as well.

The Geological Survey of Ireland recently completed a ground radiometric survey for uranium throughout much of the country. A number of anomalous areas were recorded. Follow-up evaluation is planned for the more promising anomalies.

Exploration in the Black Forest area of the Federal Republic of Germany is continuing on a modest scale. Prospecting and drilling are in progress in the Bayerische Wald, Oberpfalz and Schwartzwald areas.

NORTH AMERICA

Important discoveries in northern Saskatchewan and the Northwest Territories of Canada keep interest high. Activities in the United States are well below 1979 levels. Decline of exploration activity in the US could be about 30 percent lower than last year. In Mexico, Uranis de Mexico (URAMEX) has renewed exploration activity in the Aldama district of Chihuahua and the Reynosa district of Tamaulipas.

Canada

Saskatchewan: Exploration in Northern Saskatchewan gained momentum again this year after the important discovery at McClean Lake by Canadian Occidental Petroleum Ltd. and Inco Metals Company. Two ore deposits have been found at McClean Lake—McClean North and McClean South. The North deposit was found early in 1979. Drilling indicated a mineral zone about 2,200 feet in length and 200 feet in width. Percentage of uranium content in the ore is between 0.25 percent and 27.8 percent U_3O_8; the average U_3O_8 grade is about 2.00 percent. The South deposit was discovered about 2,000 feet from the North deposit in early 1980. The ore zone dimensions already exceed 1,000 feet in length and 200 feet in width. The percentage of contained uranium is comparable to the North deposit. Project evaluation will probably continue for several more years to completely delineate the deposits.

Saskatchewan Mining Development Corporation (SMDC) is developing two major projects—Cluff Lake and Key Lake—and continues to participate in more than 200 exploration ventures. Exploration and development expenditures by SMDC could total as much as C$33 million in 1980.

SMDC recently acquired a 20 percent interest in the Cluff Lake project from Amok. The "D" orebody is being mined and the ore stockpiled for processing in the mill, which is under construction. Mill startup is scheduled for late 1980. Mill design capacity is about 1,200 tonnes U_3O_8 per year. Development activity at the Key Lake deposit, which is jointly held by SMDC, Uranerz Exploration & Mining Company and Eldor Resources, is presently limited to development drill-

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ing and draining of the lakes over the orebodies. Reasonably assured resources for the Key Lake deposit are about 70,000 tonnes U_3O_8, making it one of the largest uranium deposits in the world. Percentage of uranium content in the ore varies between 0.72 percent to about 33.0 percent U_3O_8 and averages 2.5 percent U_3O_8. An Environmental Impact Statement was submitted to Federal and Provincial authorities in October 1979, and a Board of Inquiry has been established to determine the conditions for development of the mine-mill facility. Construction is scheduled to be completed by 1984 or early 1985.

Drilling on the Midwest Lake deposit indicates reasonably assured resources are 23,000 tonnes U_3O_8 at an average grade of 1.25 percent U_3O_8. Current plans call for property development to begin by 1983 and initial production to start in 1986 at an annual rate of 2,000 tonnes U_3O_8.

SMDC, Asamera Oil and Gas and Kelvin Energy, in a joint venture, have discovered a second ore deposit in the northern portion of the Keefe Lake-Henday Lake exploration area. The new discovery is on Keefe Lake, about 800 meters southwest of the joint venture's Dawn Lake deposit. Mineralization at the Dawn Lake deposit occurs over a strike length of about 150 meters. Both deposits are in an early stage of evaluation. Information as to size and grade of the deposits is unavailable.

The Gulf Minerals Canada Ltd., SMDC and Noranda Exploration Company Ltd. joint venture has announced a new discovery eight miles north of the Rabbit Lake site. The new deposit is called Eagle Point. Mineralization occurs in steeply dipping rock of the Wollaston Fold Belt series to a depth of 900 feet. At this time, the known length of the mineralized zone is about 3,400 feet. Evaluation of the deposit is continuing.

In summary, there are at least 16 important ore deposits in northern Saskatchewan, plus a number of favorable indications of mineralization, which remain to be evaluated. The locations of the deposits are shown in Figure 5. Reasonably assured resources are estimated at about 140,000 tonnes U_3O_8 for the district.

Ontario: The major producing area in Canada is Elliot Lake, in Ontario. Uranium occurs within two large mineralized belts known as the Quirke and Nordic ore zones. Rio Algom and Denison Mines Ltd. control most properties on the two ore zones. Rio Algom has expanded operations at its Quirke and Panel mines to 9,350 tonnes ore per day to meet contractual commitments. The Stanleigh mine will be reopened to increase production capacity another 1,535 tonnes ore per day by 1984. The average percentage of uranium content in the ore is between 0.10 percent U_3O_8 and 0.125 percent U_3O_8.

Denison Mines Ltd. is expanding capacity at the Elliot Lake mill to 13,610 tonnes ore per day. Expansion work will be completed in late 1980. In addition, Denison plans to reopen the Stanrock property, with mining scheduled to begin by 1985.

Rare Earth Resources Ltd. plans to reopen its Halo property in eastern Ontario. Uranium resources at the Halo mine are estimated at 136,000 tonnes ore at an average grade of 0.06 percent U_3O_8. Rare Earth Resources and Esso Minerals Canada are also considering the exploitation of three new deposits in the Bancroft area.

British Columbia: The Social Credit Government of British Columbia has declared a seven-year moratorium on uranium exploration and mining, citing environmental factors as reasons. The net effect of the moratorium is that rights to uranium mining will not be issued. This kills an important sector of the British Columbian mining industry and wipes out a lucrative sales contract for the development of the Blizzard Lake ore deposit near Beaverdell.

Nova Scotia: Uranium exploration activity has declined over the last year in Nova Scotia. Large land tracts have been dropped and activities are being limited to specific targets in the sandstone of the Upper Carboniferous Pictou group, the Lower Carboniferous Windsor group and granitic rocks of Devonian age.

Newfoundland Labrador: Northgate Exploration Ltd., Westfield Minerals and Shell Canada Resources Ltd., in a joint venture, are exploring uranium prospects in the Carboniferous group near the Deer Lake-Codroy Valley areas of Newfoundland. Brinco's Kitts-Michelin uranium deposits near Makkovik, in Labrador, are found in Precambrian volcanic rocks. The uranium content of the ore varies between .12 percent and .57 percent U_3O_8. Reasonably assured resources total 9,000 tonnes U_3O_8.

Northwest Territories: A major drilling program is to be carried out by Kelvin Energy in the Nonacho

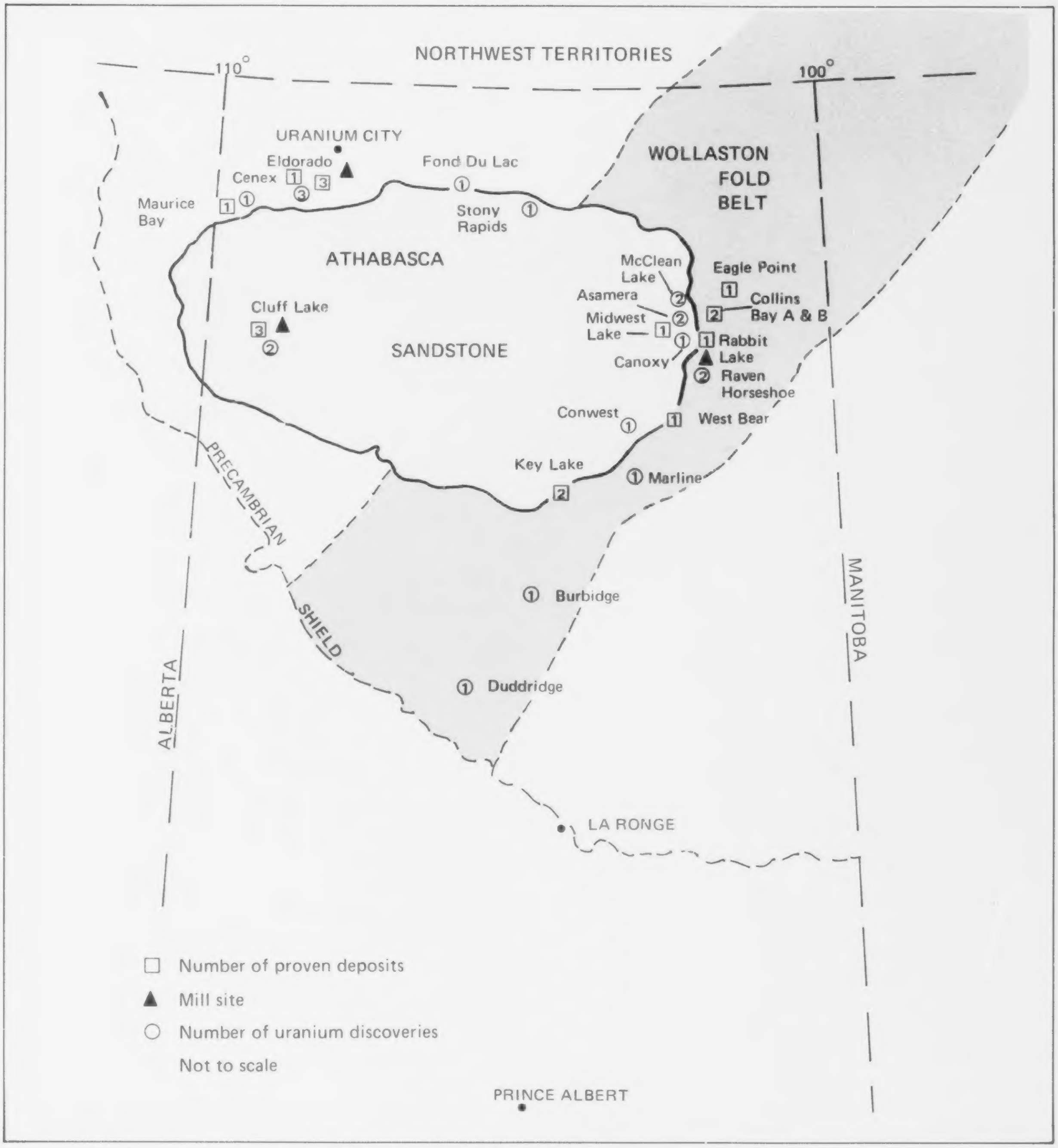
NORTHWEST TERRITORIES
110°
100°
URANIUM CITY
Eldorado
Cenex
Maurice Bay
Fond Du Lac
Stony Rapids
WOLLASTON FOLD BELT
ATHABASCA
SANDSTONE
Cluff Lake
McClean Lake
Asamera
Midwest Lake
Canoxy
Eagle Point
Collins Bay A & B
Rabbit Lake
Raven Horseshoe
Conwest
West Bear
Key Lake
Marline
PRECAMBRIAN
SHIELD
Burbidge
Duddridge
ALBERTA
MANITOBA
LA RONGE
PRINCE ALBERT
☐ Number of proven deposits
▲ Mill site
○ Number of uranium discoveries
Not to scale

Figure 5
NORTHERN SASKATCHEWAN

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Basin near Louison and Heron Lakes in the Northwest Territories, where four new uranium deposits have been discovered. Percentage of uranium content in the ore is between 0.042 percent and 32.22 percent U_3O_8 with an average grade of more than 1.5 percent U_3O_8. These four deposits represent the first important uranium to be discovered in that part of the Northwest Territories. Other areas of interest include Baker Lake where Pan Ocean and Urangesellschaft mbH & Co. have made important discoveries, and Great Slave Lake and Great Bear Lake. Principal uranium exploration areas and the important deposits in Canada are shown in Figure 6.

Resources: The Uranium Resource Appraisal Group of the Department of Energy, Mines and Resources has estimated reasonably assured resources for Canada at about 295,000 tonnes U_3O_8, of which at least 140,000 tonnes U_3O_8 are located in northern Saskatchewan. The remaining 139,000 tonnes U_3O_8 make up the resources for the rest of Canada.

United States

The United States Department of Energy reported 1979 exploration expenditures by the domestic uranium industry at about US$316 million, an increase of US$2 million over 1978 expenditures. However, exploration and development drilling was 11 million feet in 1979, down from 17 million feet in 1978. The cost variance is largely due to inflation. Reasonably assured resources increased from 835,000 tonnes U_3O_8 in 1978 to 850,000 tonnes in 1979—an increase of about 15,000 tonnes U_3O_8. Figure 7 shows the principal uranium resource areas of the U.S.

Wyoming: The highlight of the year was the announcement by The Anaconda Company of the discovery of a deposit containing 18,000 tonnes U_3O_8 on its Green Mountain property, south of Jeffery City, Wyoming. The property is controlled by Anaconda (50%), Pioneer Nuclear Inc. (25%) and Texas Eastern Nuclear, Inc. (25%). Plans to develop the property by 1985 are under consideration.

Mine and mill construction continue at the Red Desert properties held by Minerals Exploration Company. Production is scheduled to begin at the 2,700 tonnes per day complex by year end. In the Gas Hills, Pathfinder Mines Corporation has expanded its mill capacity to 2,500 tonnes per day to handle ore from the Eagle Mine located southeast of Crooks Gap. There are six in situ leach production centers in the Powder River Basin. Two are operated by Rocky Mountain Energy and one each by Cleveland Cliffs, Wyoming Mineral Corporation, Teton Nerco and Exxon Minerals, USA. Figure 8 shows the main areas of uranium activity in Wyoming.

New Mexico: The Mount Taylor project of Gulf Mineral Resources Company in McKinley County, New Mexico, is in the early stage of mine development and ore is being produced on a limited basis. The ore grade is at least 0.25 percent U_3O_8; reasonably assured resources are approximately 45,000 tonnes U_3O_8.

Phillips Uranium Corporation is developing three shafts at Nose Rock. Two shafts are at a depth below 3,000 feet—total depth will be about 3,200 feet (work on the third shaft was recently terminated). Conoco Inc. and Wyoming Mineral Corporation are performing development work on a deposit at Crownpoint. The first access shaft is presently being drilled to a depth of 2,250 feet. The ore depth is about 2,100 feet. Exploration is still concentrated in the known districts of New Mexico, but interest is spreading to new areas such as the Costilla Mountains near Taos. Figure 9 shows the location of mines and mills in the Grants uranium belt.

Utah: New deposits are being developed near La Sal in the southwest area of the Colorado Plateau by Union Carbide Corporation and Atlas Corporation. Atlas is now mining from its Velvet property—a high grade deposit in Lisbon Valley. The Dirty Devil River district of southeast Utah is the recent scene of renewed exploratory drilling by Cotter Corporation. Initial drilling results indicate important mineralization at a depth of 1,600-1,700 feet. Energy Fuels Ltd. began production in May at its mill located near Blanding. Capacity is 1,700 tonnes ore per day. Plateau Resources plans to complete construction of a mine and mill complex on Ticaboo Mesa in 1981. Planned capacity is 900 tonnes ore per day.

Arizona: In Arizona, Anamax Mining, a joint venture between the Anaconda Company and Amax Corporation, is producing uranium as a by-product at its Twin Buttes copper mine and milling complex in Sahurita, south of Tucson. The first shipment of concentrates was made in April, 1980. Uranium production is expected to be about 64 tonnes U_3O_8 per year.

Colorado: Amoco Minerals Corporation, formerly

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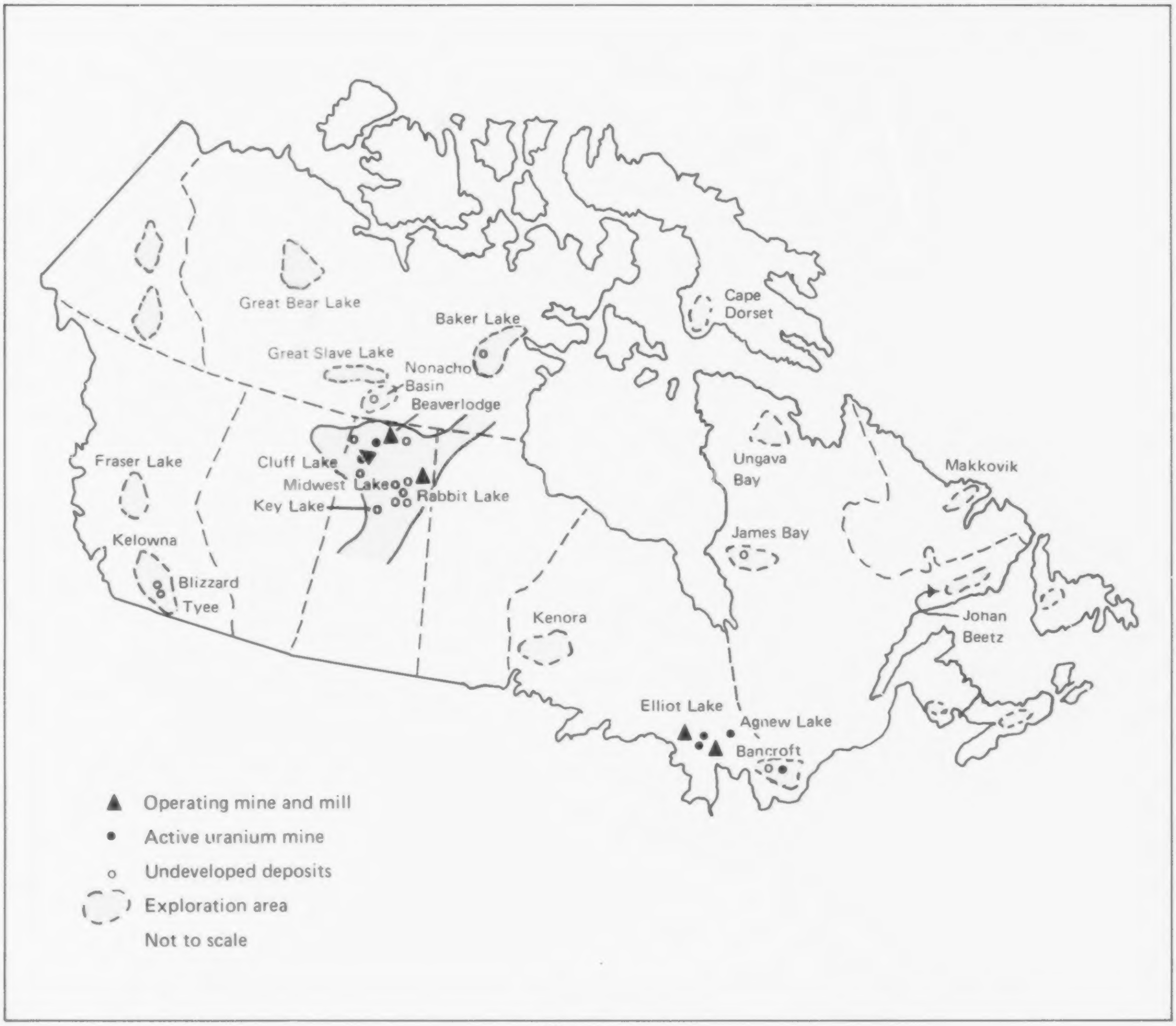
Great Bear Lake
Baker Lake
Cape Dorset
Great Slave Lake
Nonacho Basin
Beaverlodge
Fraser Lake
Cluff Lake
Midwest Lake
Key Lake
Rabbit Lake
Ungava Bay
Makkovik
Kelowna
Blizzard
Tyee
James Bay
Kenora
Johan Beetz
Elliot Lake
Agnew Lake
Bancroft
▲ Operating mine and mill
● Active uranium mine
○ Undeveloped deposits
Exploration area
Not to scale

Figure 6
URANIUM DEPOSITS AND EXPLORATION AREAS IN CANADA

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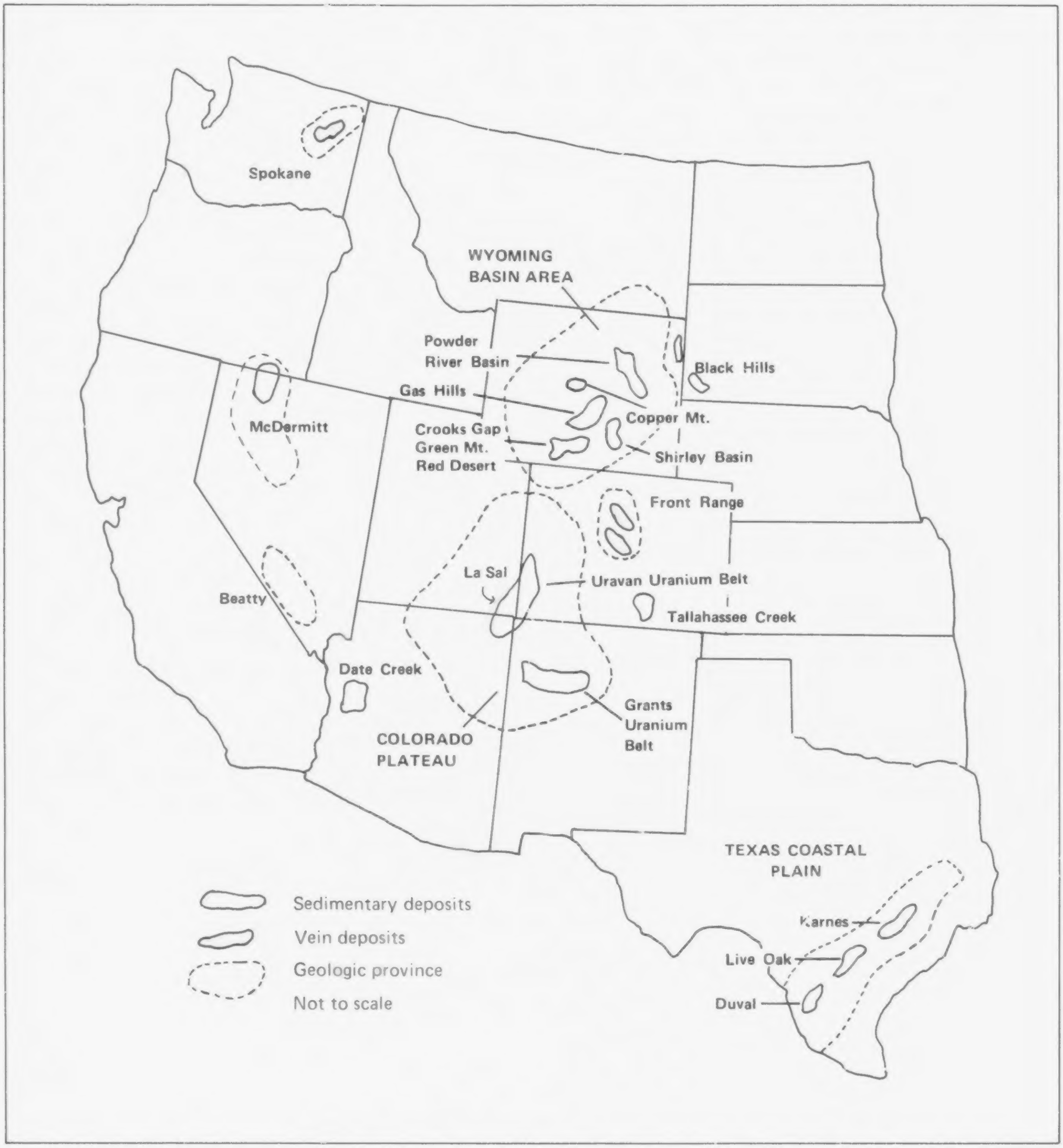
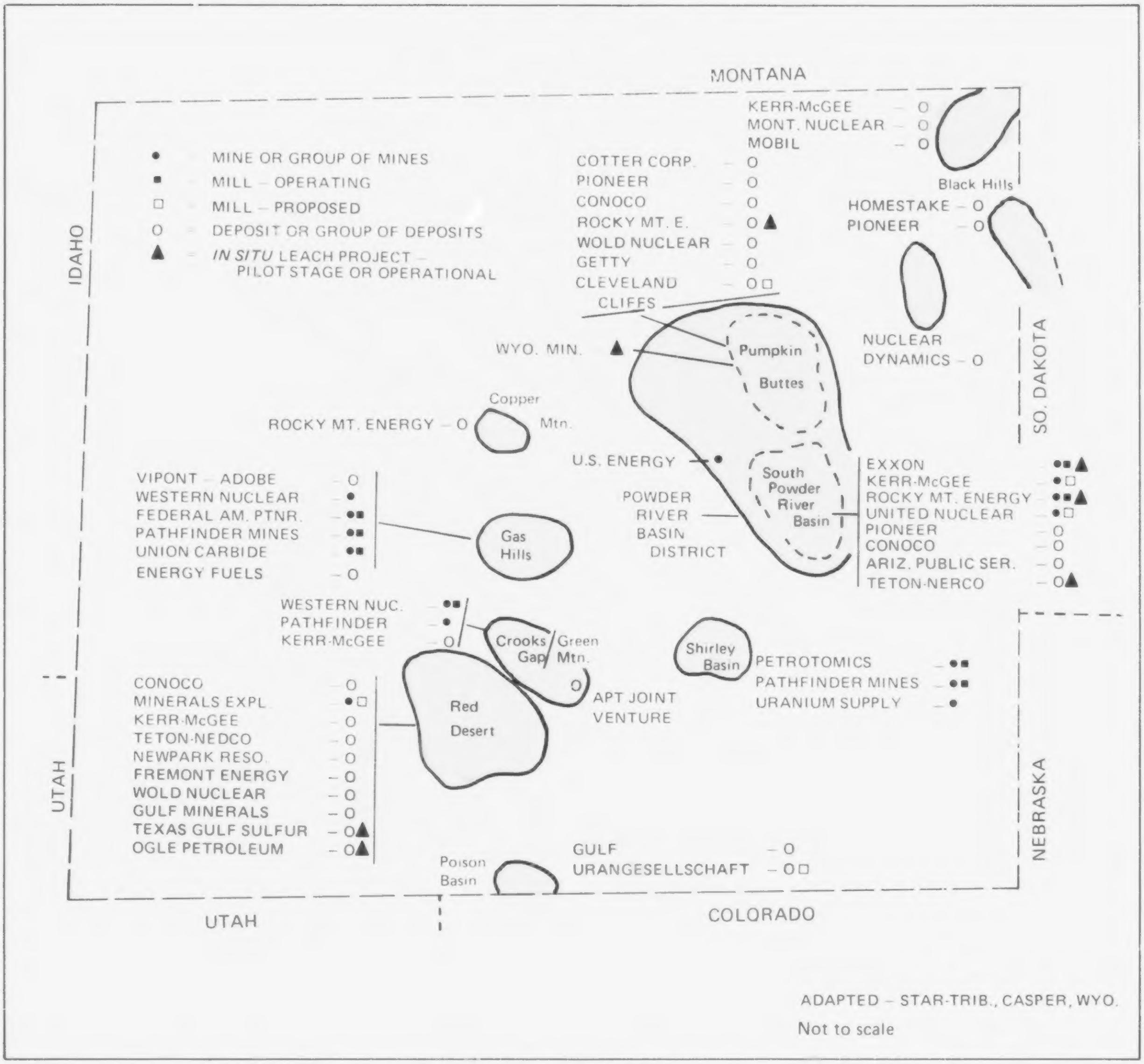

Spokane
WYOMING
BASIN AREA
Powder
River Basin
Gas Hills
Crooks Gap
Green Mt.
Red Desert
Copper Mt.
Shirley Basin
Black Hills
McDermitt
Front Range
La Sal
Uravan Uranium Belt
Tallahassee Creek
Beatty
Date Creek
COLORADO
PLATEAU
Grants
Uranium
Belt
TEXAS COASTAL
PLAIN
Karnes
Live Oak
Duval
Sedimentary deposits
Vein deposits
Geologic province
Not to scale

Figure 7
PRINCIPAL URANIUM RESOURCE AREAS OF THE UNITED STATES


MONTANA
IDAHO
SO. DAKOTA
NEBRASKA
UTAH
UTAH
COLORADO
● MINE OR GROUP OF MINES
■ MILL – OPERATING
□ MILL – PROPOSED
○ DEPOSIT OR GROUP OF DEPOSITS
▲ IN SITU LEACH PROJECT – PILOT STAGE OR OPERATIONAL
KERR-McGEE – ○
MONT. NUCLEAR – ○
MOBIL – ○
Black Hills
COTTER CORP. – ○
PIONEER – ○
CONOCO – ○
ROCKY MT. E. – ○▲
WOLD NUCLEAR – ○
GETTY – ○
CLEVELAND CLIFFS – ○□
HOMESTAKE – ○
PIONEER – ○
NUCLEAR DYNAMICS – ○
WYO. MIN. ▲
Pumpkin Buttes
Copper Mtn.
ROCKY MT. ENERGY – ○
U.S. ENERGY – ●
South Powder River Basin
POWDER RIVER BASIN DISTRICT
EXXON ●■▲
KERR-McGEE ●□
ROCKY MT. ENERGY ●■▲
UNITED NUCLEAR ●□
PIONEER ○
CONOCO ○
ARIZ. PUBLIC SER. – ○
TETON-NERCO – ○▲
VIPONT – ADOBE – ○
WESTERN NUCLEAR – ●
FEDERAL AM. PTNR. – ●■
PATHFINDER MINES – ●■
UNION CARBIDE – ●■
ENERGY FUELS – ○
Gas Hills
WESTERN NUC. – ●■
PATHFINDER – ●
KERR-McGEE – ○
Crooks Gap
Green Mtn.
APT JOINT VENTURE
Shirley Basin
PETROTOMICS – ●■
PATHFINDER MINES – ●■
URANIUM SUPPLY – ●
CONOCO ○
MINERALS EXPL. ●□
KERR-McGEE – ○
TETON-NEDCO – ○
NEWPARK RESO. – ○
FREMONT ENERGY – ○
WOLD NUCLEAR – ○
GULF MINERALS – ○
TEXAS GULF SULFUR – ○▲
OGLE PETROLEUM – ○▲
Red Desert
Poison Basin
GULF – ○
URANGESELLSCHAFT – ○□

ADAPTED – STAR-TRIB., CASPER, WYO.

Not to scale

Figure 8
PRINCIPAL URANIUM DISTRICTS OF WYOMING SHOWING PARTIAL LIST OF COMPANY ACTIVITY

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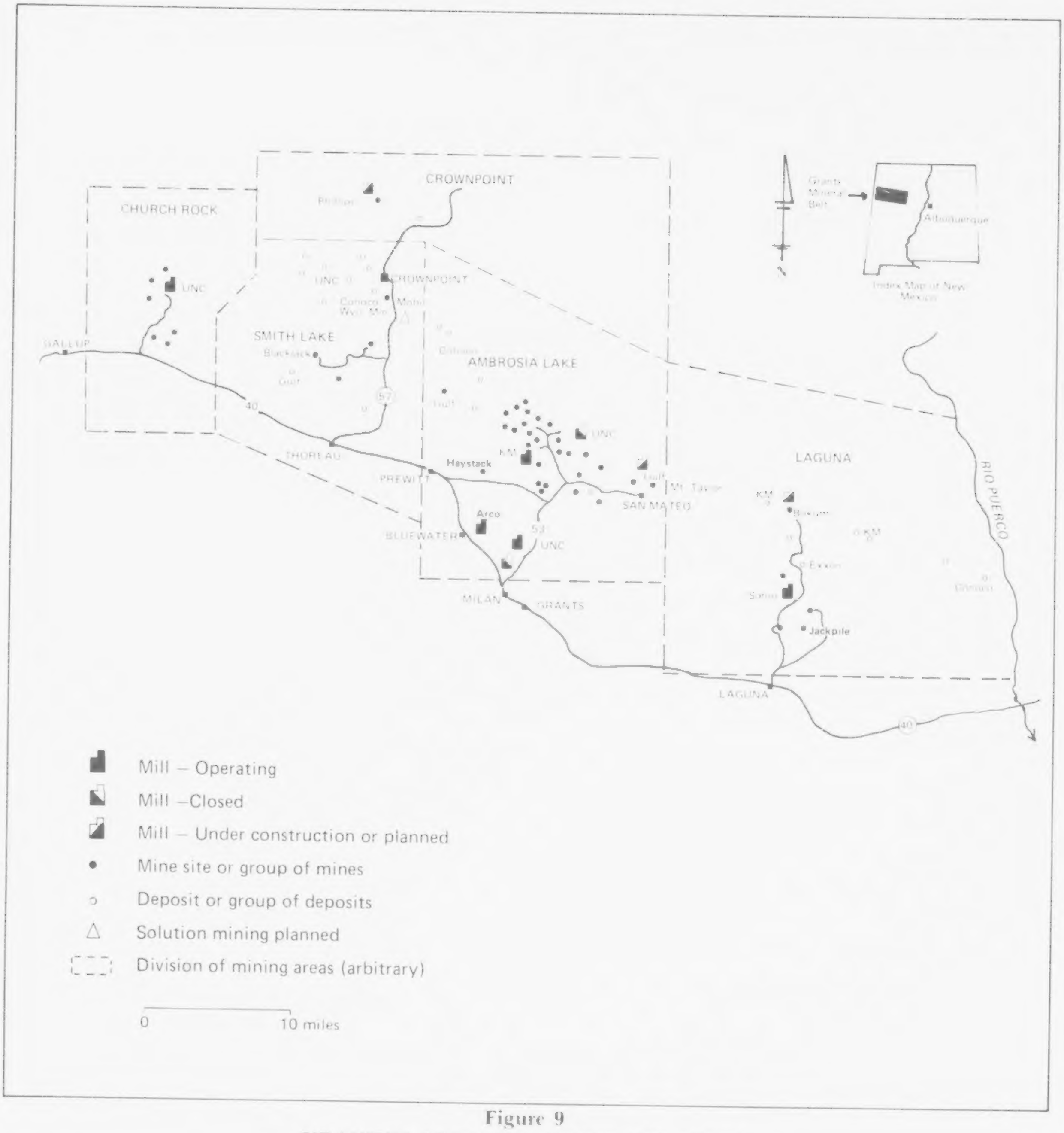
CROWNPOINT
CHURCH ROCK
Phillips
UNC
CROWNPOINT
Conoco
Wyo. Min.
Mobil
SMITH LAKE
Blackjack
Gulf
GALLUP
40
57
Cobalt
AMBROSIA LAKE
Gulf
UNC
KM
Haystack
THOREAU
PREWITT
Gulf
Mt. Taylor
SAN MATEO
Arco
53
UNC
BLUEWATER
MILAN
GRANTS
Grants Mineral Belt
Albuquerque
Index Map of New Mexico
LAGUNA
KM
Bokum
KM
Exxon
Sohio
Jackpile
RIO PUERCO
LAGUNA
40
▙ Mill – Operating
◣ Mill – Closed
◢ Mill – Under construction or planned
● Mine site or group of mines
○ Deposit or group of deposits
△ Solution mining planned
▭ Division of mining areas (arbitrary)
0
10 miles

Figure 9
URANIUM DEPOSITS, MINES AND MILLS
IN THE GRANTS URANIUM BELT, NEW MEXICO

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Cyprus Mines Corporation, and Wyoming Mineral Corporation have postponed development of the Hansen deposit in the Tallahassee Creek area northwest of Canon City for at least two years. Homestake Mining Company began mining at its Marshall Pass property at a rate of 550 tonnes of ore per month. Homestake is continuing its efforts to obtain permits for the construction and operation of a mill. Planned mill capacity is 1,100 tonnes per day.

Nevada: Placer Amax Inc. has identified a deposit containing about 6,500 tonnes U_3O_8 at its McDermitt property in the north central part of Nevada. Mineralization occurs in a large Tertiary caldera structure. Caldera structures and Tertiary formations in Nevada are being investigated for uranium mineralization by a number of companies as a result of the exploration success at McDermitt. Uranium occurrences are known in the Beatty Caldera (see Figure 7).

Texas: Exploration and development activity in Texas is continuing at a high level, due primarily to favorable actions by state regulatory agencies toward new property development. There are 13 in situ leach plants operating in the Coastal Plain district of Texas with an estimated production capacity of about 2,500 tonnes U_3O_8 annually. Five plants under construction are scheduled for completion by the end of the year. The five plants will increase annual production capacity by another 635 tonnes U_3O_8. However, present rate of production is about 1,350 tonnes U_3O_8 per year.

Conoco Inc. plans to strip mine about 91,000 tonnes ore from its Tom-Retzloff leases in Atascosa County, in south Texas. Excavation depths will average 116 feet over the 54 acre site. The Anaconda Company has applied for approval to mine a 570,000 tonne deposit on the Rhode Ranch site in McMullen County. The proposal would permit Anaconda to mine the deposit over a 10-year period.

Florida: The phosphate deposits in the southeastern United States contain about 12 billion tonnes of potentially minable phosphorite resources. The deposits in the central and southern areas of Florida, contain about 1.8 billion tonnes of minable phosphate which contains about 200,000 tonnes U_3O_8 at an average grade of .015 percent U_3O_8. Uranium is being recovered as a by-product to phosphoric acid at three uranium recovery plants now operating in central Florida and one plant in Louisiana. Annual recovery capacity is about 1,050 tonnes U_3O_8. Three plants under construction will increase capacity by 730 tonnes U_3O_8 per year by 1982.

Other: In Washington State, 25,000 acres of the Spokane Indian Reservation is planned to be explored for uranium by Minatome Corporation. A dozen or more companies are actively exploring the favorable areas of the district. Dawn Mining Company is stripping another ore zone at the Midnight mine. The Dawn mill at Ford is operating at a capacity of 365 tonnes per day. Western Nuclear Inc. is operating the Sherwood mine and mill at a rate of 1,825 tonnes per day.

Drilling by Standard Metals Corporation at Alaska's Kendrick Bay indicates reasonably assured resources at 330,000 tonnes of ore with an average grade of 0.17 percent U_3O_8. So far, about 250 holes have been drilled.

Exploration activities in the U.S. decreased about 13 percent in 1979 below the previous year according to USDOE. However, for the first half of 1980, the decrease in activity was 37 percent below the 1979 level. The decrease clearly reflects a reaction by exploration groups to sharply falling U_3O_8 prices.

The annual decrease in exploration activity shows a correlation with the market value for U_3O_8 concentrates. Figure 10 is a graphic comparison of drill footage, Nuexco's Exchange Value for the period 1973 through August 1980 and annual expenditures for exploration drilling operations. The graph illustrates a lag in response time by exploration groups to changes in the market. As the Exchange Value increased and then stabilized during the 1974-1979 period, the lag in reaction time by exploration groups was about one year.

Since early 1980, the lag time has decreased considerably. The Nuexco Exchange Value has decreased by 30 percent since January; drill activity for the period of January through June 1980 is down 37 percent from the same period in 1979, and drill expenditures for January through June 1980 are estimated at 31 percent below the same period in 1979. When the Exchange Value began its sharp decline in early March 1980, exploration was quickly curtailed as the first means to control expenditures. The declining trend in exploration is presently gaining momentum, primarily among smaller exploration groups. Delays and cancellations of developing projects have taken a serious downward turn as well.

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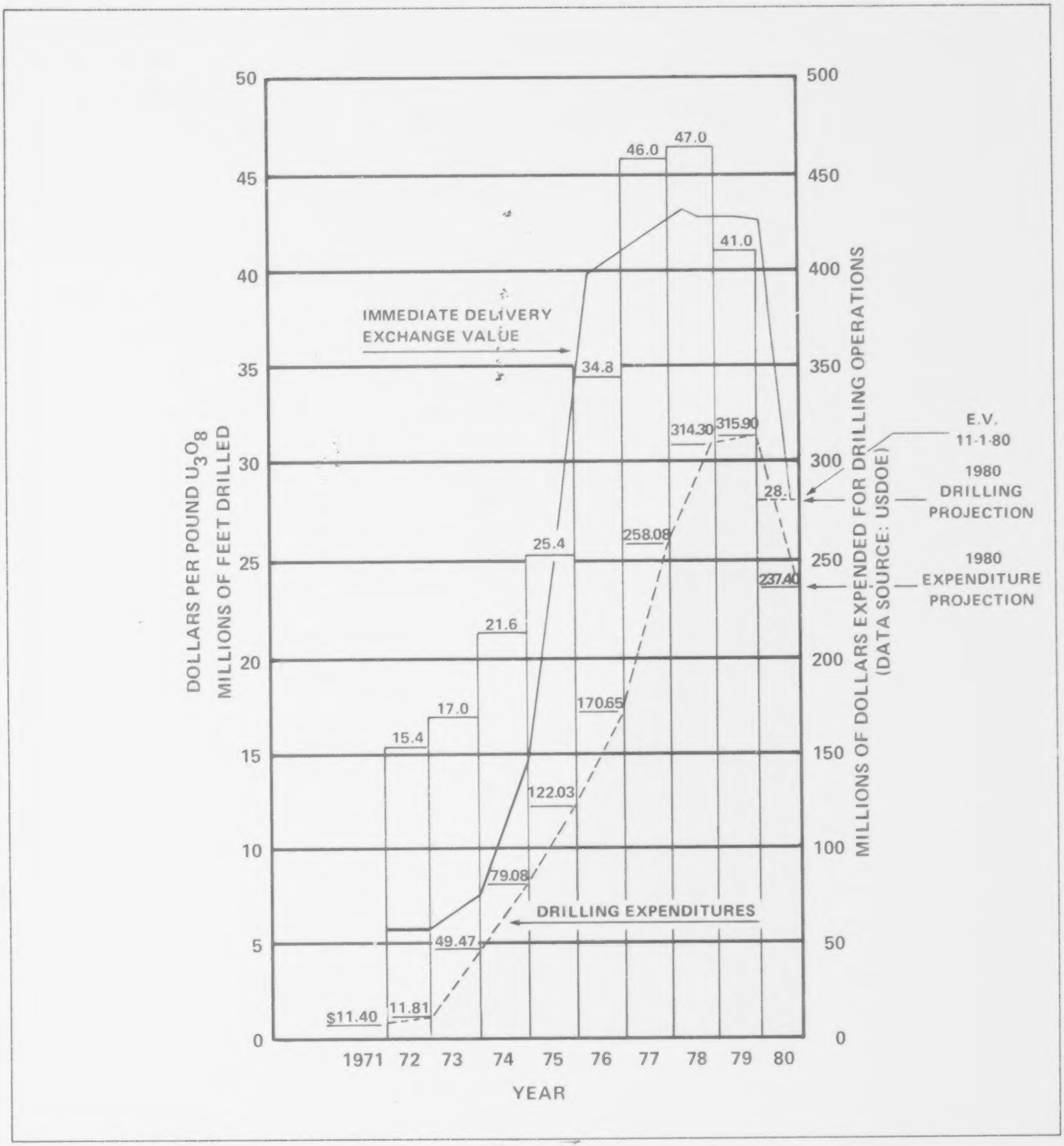

Figure 10

GRAPHIC COMPARISON—DRILL FOOTAGE, NUEXCO EXCHANGE VALUE AND ANNUAL EXPLORATION EXPENDITURES FOR THE U.S.

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Mexico

Exploration activity has only recently resumed in Mexico under the direct guidance of Urania de Mexico (URAMEX), a division of the Ministry of National Ownership and Industrial Development. Reasonably assured resources in Mexico remain unchanged at about 7,600 tonnes U_3O_8. URAMEX is exploring in the Aldama district of Chihuahua and along the prominent ore trend in the Reynosa area of Tamaulipas—the same ore trend that extends for several hundred miles through south Texas.

URAMEX has not announced a program to develop ore deposits in either district. However, URAMEX is considering the replacement of the processing mill located near Aldama, which is not operating, with an entirely new facility located near El Sauz. The capacity and completion date of the mill have not been announced by URAMEX. Areas of interest are shown on Figure 11.

SOUTH AMERICA

Uranium exploration and development activities have increased in a number of South American countries. Uranium occurrences have been discovered through the application of preliminary exploration techniques in Bolivia, Colombia, Peru, Ecuador, Venezuela, Uruguay and Chile. Important discoveries have been made in Argentina and Brazil, with ore deposits in both countries being developed. The location of known deposits and mill sites is shown in Figure 11.

Argentina

The most important uranium deposits in Argentina occur in Jurassic and Cretaceous sediments in Mendoza province. However, additional deposits and prospects are known to occur in sediments in Jujuy and Salta provinces as well. Vein deposits and disseminated mineralization have been found in Precambrian rocks in the provinces of Cordoba, La Rioja and Nuequen.

The largest deposits now under development are located in the Sierra Pintada district of Mendoza. At least 12 minable deposits are known to occur in Jurassic sediments in the district. Reasonably assured resources are estimated to exceed 16,000 tonnes U_3O_8 in all deposits; however, the Tigre I and III deposits contain about 15,000 tonnes of the total. Mining is in progress at the Tigre I and III deposits, as well as small satellite deposits, at a rate of about 50 tonnes U_3O_8 per year. The ore is trucked to a processing mill in the Malargue district, located 180 kilometers to the south. A number of small deposits are being explored and developed in the Malargue district as well. The uranium mineralization occurs in a geologic environment similar to that at Sierra Pintada.

Approximately 30 tonnes U_3O_8 are produced annually at the Don Otto mine and mill in Salta province; the uranium is mined from Cretaceous rocks. Another 25 tonnes U_3O_8 are mined from crystalline rocks at the Rudolfo and Los Gigantes deposits and milled at Cosquin, in Cordoba province. In southern Argentina, 35 tonnes U_3O_8 per year are being produced at the Los Adobes mine and mill in Chubut province.

Reasonably assured resources in Argentina are estimated by the National Atomic Energy Commission (CNEA) at about 28,000 tonnes U_3O_8 compared to 21,000 tonnes in 1978. U_3O_8 production was about 140 tonnes in 1979. Plans to expand production capacity to at least 400 tonnes U_3O_8 are under consideration. In fact, the additional capacity could be available as early as 1983.

A new mining law was passed on July 1, 1980. It grants the CNEA the authority to establish exclusive uranium prospecting areas and regulate exports of nuclear material. In this new role, CNEA is currently considering loaning 240 tonnes of uranium concentrate (yellowcake) to Nuclebras—the Brazilian nuclear company.

Brazil

Uranium exploration and development activity in Brazil is directed by Nuclebras, either independently or in a joint venture with Urangesellschaft mbH & Co. of West Germany. The Itataia deposit in Ceara state is the largest in Brazil with reasonably assured resources of about 75,000 tonnes U_3O_8. The deposit is still being evaluated. The Pocos de Caldas deposit in Minas Gerais contains an estimated 20,000 tonnes U_3O_8. It is under development and could be in production at a rate of 150 tonnes U_3O_8 per year by early 1981. It will be the first production center in Brazil.

Reasonably assured resources of the Figueira deposit in Parana state are about 6,000 tonnes U_3O_8. The deposit appears to be a typical roll-front occurrence in Paleochannel sands. Development of the deposit is under consideration. The potential for

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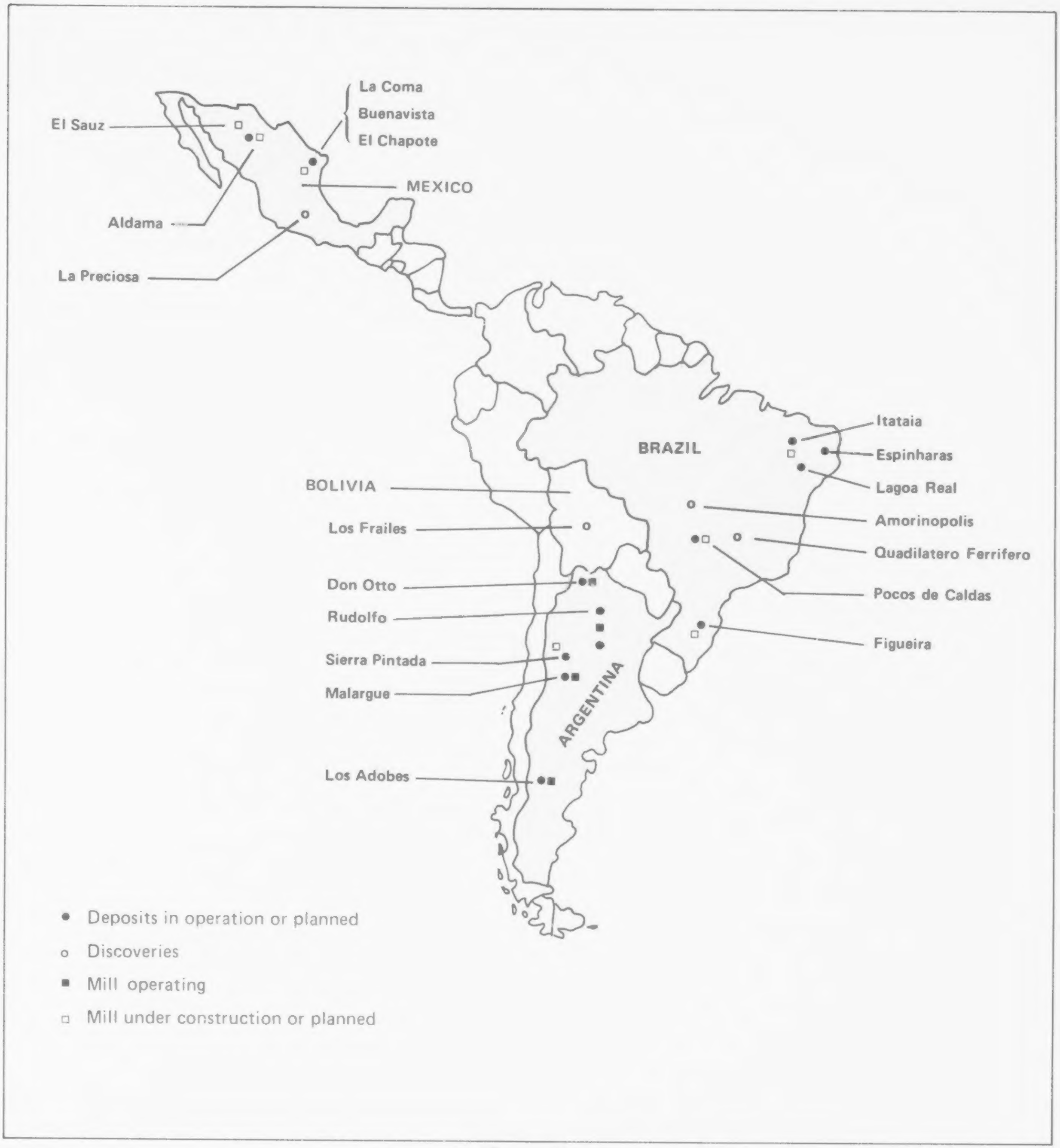
La Coma
Buenavista
El Chapote
El Sauz
MEXICO
Aldama
La Preciosa
Itataia
BRAZIL
Espinharas
Lagoa Real
BOLIVIA
Amorinopolis
Los Frailes
Quadilatero Ferrifero
Pocos de Caldas
Don Otto
Rudolfo
Figueira
Sierra Pintada
Malargue
ARGENTINA
Los Adobes
● Deposits in operation or planned
○ Discoveries
■ Mill operating
□ Mill under construction or planned

Figure 11
URANIUM DEPOSITS AND OCCURRENCES IN LATIN AMERICA

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additional resources at the deposit is excellent. An additional 14,000 tonnes U_3O_8 occur in the Espinharas, Campos Belos, Lagoa Real, Amorinopolis and Quadilatero Ferrifero deposits in eastern Brazil.

Nuclebras estimates Brazil's reasonably assured resources at 115,000 tonnes U_3O_8.

Bolivia

Bolivia's first uranium mine and mill will soon begin limited production at an annual rate of four tonnes U_3O_8 at the Cotage Mine in south Bolivia. A number of uranium occurrences have been identified in Tertiary volcanic rocks of the Cordillera de Los Frailes range. The Bolivian Nuclear Energy Commission (COBOEN) directs all exploration and production activity. The main area of interest is the sedimentary basins of southern Bolivia, where COBOEN and AGIP Uranium of Italy are exploring under the conditions of a joint venture.

Colombia

A government agency, Compania Colombiana de Uranio (COLURANIO) directs all uranium exploration. Future development of uranium deposits will be controlled by the Instituto de Asuntos Nucleares (I.A.N.). Exploration joint ventures are in progress with Enusa of Spain and Power Reactor and Nuclear Fuels Development Corporation of Japan. The foreign partners can earn a 49 percent interest in all discoveries by committing 100 percent of exploration expenditures.

RESOURCE SUMMARY

The uranium resources of the Free World are tabulated in Table 3. Total resources are subject to constant change as exploration and production results are confirmed. The summary is based on public sources, superseded by Nuexco estimates where appropriate.

Table 3

SUMMARY OF WORLD URANIUM RESOURCES
Reasonably assured at US$50.00 or less per pound U_3O_8

Country	Tonnes U_3O_8	Totals
AFRICA:		
South Africa	452,000	
Namibia	104,000	
Niger	195,000	
Algeria	33,000	
Gabon	24,000	
Israel	36,000	
Central African Empire	9,500	
Egypt	5,000	
		858,500
ASIA:		
Japan	8,200	
India	30,000	
		38,200
AUSTRALIA:		465,200
EUROPE:		
France	93,600	
Spain	12,500	
Portugal	9,000	
Sweden	1,200	
Greenland (Denmark)	32,000	
Italy	1,200	
Greece	1,000	
Yugoslavia	8,000	
		158,500
NORTH AMERICA:		
Canada	279,000	
United States	850,000	
Mexico	7,600	
		1,136,600
SOUTH AMERICA:		
Argentina	28,000	
Brazil	115,000	
		143,000
TOTAL REASONABLY ASSURED URANIUM RESOURCES:		2,800,000

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NUEXCO

DECEMBER 1980 NUMBER 148

Monthly Report on the Uranium Market

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 148

The **Exchange Value** remained unchanged this month at \$28.00 per pound U_3O_8. There was little evidence last month of price cutting by sellers to effect sales. However material available for sale for spot or near term delivery now amounts to 8.4 million pounds U_3O_8 (2.1 million from producers, the balance from inventory holders), whereas there is very little spot and near term demand. This imbalance might be expected to put downward pressure on prices this month especially since some of the active sellers in the market may wish to include sales in fiscal 1980 results.

The **Transaction Value** declined slightly to \$28.70 per pound U_3O_8 from \$29.00 last month. Three sales transactions closed last month, all at fixed prices for 1981 delivery. All three sales were for amounts between 100,000 and 300,000 pounds U_3O_8. It is apparent that sellers are willing to fix prices for delivery and payment many months in the future. The transactions which closed this month involved some deliveries to mid to late 1981 at fixed prices at or near this month's Exchange Value.

The election of Ronald Reagan as President has sparked a new sense of optimism in the **US** nuclear industry. However the new Administration is not expected to have any near term influence on the uranium industry. The issue of nuclear power and the new political environment is discussed in detail in the *Commentary* section of this month's Nuexco Report.

In **Canada**, a licensing decision by the Key Lake Board of Inquiry is expected soon. Key Lake is one of the world's largest and richest uranium deposits. If licensing of the facility is approved, the owners' plans now call for annual production in the eight to ten million pound range, which would make Key Lake one of the world's largest production centers.

The **Australian** government announced last month that it would permit reprocessing of Australian source uranium in connection with power production under certain conditions, including the requirement that the recovered plutonium be safeguarded against nuclear proliferation. This new policy on reprocessing is based upon the conclusions of the INFCE study, and is expected to improve the prospects of additional sales of Australian uranium, especially to **France.**

This month's *Raw Materials* section contains a description of the Schwartzwalder mine in the Front Range of Colorado.

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NUEXCO

MONTHLY REPORT ON THE URANIUM MARKET

December 1980 No. 148

JAMES E. VAUGHAN, *EDITOR*

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FOREWORD

Nuexco President Bob Wolcott made an address to the Alternative Energy Sources Committee of the New Mexico Legislature. A copy of his remarks is included as an insert to this Report.

We made a systematic error in the data production for Table 6 of Report 147 (November 1980). A corrected copy of Table 6 is included as an insert to this Report.

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URANIUM MARKET

AUSTRALIA

As noted last month, Prime Minister Fraser's Liberal-National country coalition now commands a comfortable 23-seat margin in the Australian House of Representatives. But the final results of the 64-seat Australian Senate elections show the Liberal-National Country coalition won only 31 seats rather than the 32 indicated earlier. The seat which was lost went to the Democrats. The Democrats hold five seats, one seat is held by an independent and the final 27 by Labor. While lacking a majority, the government coalition, together with support from Tasmanian Senator Harradine, the independent, can block any legislation proposed jointly by Labor and the Democrats, and thus, no practical problems are foreseen for either the Fraser Government or its pro-uranium policies.

Deputy Prime Minister Anthony recently commented that "a large proportion of the production from . . . existing approved uranium projects (Mary Kathleen, Ranger, Nabarlek and Yeelirrie) is already committed." Indicating that he felt such commitments reflected confidence in Australia, its reliability and capacity to supply, Anthony went on to say that "the position has now been reached where additional uranium projects should proceed so the momentum of Australia's advance into the world market can be maintained."

Based on recent demand forecasts, Mr. Anthony's comments appear to be very optimistic. Despite the desires of a number of Australian organizations to move into production as soon as possible, the ability to obtain sales commitments will, in the last analysis, determine when new projects will get under way. The changing market situation is nowhere better reflected than in the sharply lower prices that Japanese buyers have proposed for 1981 deliveries from Australian producers. Whereas 1980 prices were in the mid-$40 per pound U_3O_8 range, it can be expected that 1981 prices, when finally settled, could be in the mid-$30 range.

In Nuexco Report No. 146, Japanese participation in the Ranger project through Japan-Australia Uranium Resource Development Company, Ltd. (JAURD) was described in some detail. Ninety percent of JAURD is owned by three utilities, Kansai, Kyushu and Shikoku, and, contrary to previous reports, JAURD's staff and management is provided primarily by these utilities, not C. Itoh.

The Australian Minister for Foreign Affairs announced last month that the Government has decided to permit reprocessing of Australian origin uranium under certain conditions. The conditions outlined by the Minister for approval of reprocessing include:

1. Reprocessing will be allowed in association with power production.
2. Storage and use of the plutonium would be in a manner that causes no danger of nuclear proliferation.
3. Agreement by the end user of continued consultation and review of the conditions for reprocessing.
4. End user commitment to support development of more effective international control measures.

This decision by Australia is expected to substantially improve prospects for additional uranium sales, especially to France.

CANADA

The energy policy in Canada remains uncertain. It is complicated by uncertainties surrounding the debate on the new Canadian Constitution. The Constitution has been viewed by the provinces as a threat to their control of the use and sale of natural resources occurring within provincial boundaries, a power now vested with the provinces under the British North America Act, which serves as the current Canadian Constitution.

Part of the controversy surrounding the Constitution revolves around the shift of Canadian "money capitals" westward. This shift is due mainly to the strength gained by the western provinces through oil, gas and other resources. Thus it is partly an *east vs. west* problem.

The east vs. west controversy is very apparent in the uranium industry, with new production coming on line in Saskatchewan. Development of the new production centers will be regulated by the province, but export conditions will be regulated by the Federal government.

Development of the Key Lake deposit in northern Saskatchewan is currently awaiting approval of the Environmental Impact Statement by the Key Lake Board of Inquiry. A decision is expected shortly. Key Lake, jointly held by Saskatchewan Mining Development Corporation (SMDC), Uranerz Canada, and Eldor Resources, is one of the largest and richest uranium deposits in the world. Announced reserves are about 70,000 metric tons U_3O_8 at an average grade of 2.5 percent U_3O_8. The production center planned

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by the joint owners is larger than had previously been assumed, in the region of eight to ten million pounds U_3O_8 annually. While the ability to market the output will probably determine the ultimate size of the facility, it would appear that the magnitude and grade of the deposit would lead to economics of scale and operating economies that should enable Key Lake to compete favorably for market share.

EUROPE

Pro-nuclear groups in Austria were successful in obtaining enough voter signatures to require the Austrian Parliament to consider whether to have another national nuclear referendum. If the Parliament approves by a two-thirds majority vote, then a new referendum will be placed on the ballot concerning the law which now prohibits operation of the Zwentendorf nuclear power plant. The decision by Parliament is not expected before February 1981.

FAR EAST

Korea Electric Company announced this month that it has signed contracts with Framatome and Cogema of France for nuclear equipment and fuel for Korea's eighth and ninth nuclear plants. The plants will be 950 MWe units, and are scheduled for startup in 1987 and 1988. The fuel contract with Cogema involves a ten year supply of enriched uraniem for both units.

UNITED STATES

The election of Ronald Reagan as President has prompted a sense of optimism throughout the US nuclear industry. Mr. Reagan's pronuclear attitudes, combined with the Republican controlled Senate, are expected to eventually lay a new political foundation for the nuclear industry. The issue of the possible effect of the new Administration on the nuclear industry is discussed in detail in the *Commentary* section of this Report.

The Alternative Energy Sources Committee of the New Mexico Legislature is holding hearings on the New Mexico severance tax on uranium. The severance tax was enacted in 1977 and increased in 1980. New Mexico's share of US uranium production has decreased from 18 percent in 1976 to 10 percent in 1979, and is expected to decline again in 1980. One contributing cause of the decline might be the fact that New Mexico's severance tax is by far the highest in the nation. Table 1 compares severance taxes in four major uranium producing states. The high tax rate in New Mexico is further magnified by the fact that it is applied to the value of uranium concentrates rather than at the mine mouth on the value of unprocessed ore.

Table 1

URANIUM SEVERANCE TAXES IN FOUR URANIUM PRODUCING STATES[1]

State	Severance Tax at \$30/lb U_3O_8 Sales Price (\$/lb U_3O_8)
New Mexico[2]	2.375
Wyoming[3]	0.30-0.45
Utah[4]	0.20-0.30
Texas	none

[1] Source: Lynn Jacobsen "New Mexico Uranium Severance Taxes," October, 1980.

[2] A temporary credit of 50 percent of the tax due on the first 100,000 pounds is available in FY 1980-81; on 75,000 pounds in FY 1981-82; and on 50,000 pounds in FY 1982-83.

[3] Varies with grade of ore.

[4] Varies with transportation and milling cosas; a \$50,000 exemption.

TRANSACTIONS

Three sales transactions were concluded this month. One sale from a US producer to a US utility involved between 100,000 and 300,000 pounds U_3O_8, with delivery to take place in the latter half of 1981. Another sale was made from a US producer to a US nuclear contractor for delivery near the end of 1981. The quantity involved was 100,000 to 300,000 pounds U_3O_8. Finally, a European based producer sold between 100,000 to 300,000 pounds U_3O_8 to a European utility with delivery to occur early in 1981.

PRICING

While there were indications of continued weakening of the uranium market this month, sufficient activity took place at the \$28.00 level to allow the Exchange Value to remain unchanged.

Current demand is still composed of discretionary buyers, utilities purchasing for inventory and producers buying rather than making to fulfill existing

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commitments. The sellers in this market are primarily inventory holders seeking to generate revenue or reduce inventory levels. There are also large quantities of material available from producers. Total uranium available for sale (see Market Opportunities section of this Report) and delivery within the next year is about 8.4 million pounds U_3O_8 equivalent, of which about 2.4 million pounds are available from primary producers. The total of active inquiries to buy for delivery within the next year has dropped to only 200,000 pounds U_3O_8. While this imbalance is great enough to have precipitated major drops in the Exchange Value in the past, there has been little evidence so far of sellers offering at major price concessions in order to move material. However with the end of the year approaching, some sellers may want to close spot sales this month in order to include them in fiscal 1980 results. This fact, combined with the present severe market imbalance, might put some downward pressure on the market.

Spot and near term inquiries to sell and inquiries to purchase, as published by Nuexco in 1980, are tabulated in Table 2. The differences between the two, the supply excesses, are also tabulated. The supply excess increased to above three million pounds U_3O_8 in early 1980, and generally remained at about three million pounds throughout 1980, until it increased to 6.3 million pounds in November, and 8.2 million pounds this month. The effect of this supply imbalance on price will depend on how aggressively the sellers attempt to market their material. As yet, there has been little indication of serious price cutting. However the absence of active buyers in the spot and near term markets might lead to price cutting if new buyers are to be attracted into the market.

Another indication of the weakened market is the manner in which some contracts for intermediate term delivery are being priced. Until recently, sales for delivery more than about one year after contract signature were either priced at market at time of delivery, or at an escalated price or some combination. Now, however, transactions are closing at fixed prices for delivery and payment in late 1981 and 1982.

The *Transaction Value* decreased slightly this month to \$28.70 per pound U_3O_8, from \$29.00 last month.

Table 2

SPOT AND NEAR TERM SUPPLY AND DEMAND FIGURES PUBLISHED BY NUEXCO DURING 1980

Nuexco Report Number	Spot and Near Term Inquiries (Millions of Pounds U_3O_8) To Sell	To Purchase	Difference	Exchange Value (\$/lb U_3O_8)
137	3.75	2.45	1.3	40.75
138	4.13	2.05	2.1	40.00
139	4.08	0.50	3.6	38.00
140	4.05	1.00	3.1	35.00
141	3.75	1.90	1.9	32.00
142	4.20	1.20	3.0	32.00
143	4.10	0.75	3.4	31.50
144	3.33	0.23	3.1	31.50
145	3.95	0.17	3.8	30.00
146	4.73	2.05	2.7	28.50
147	7.45	1.10	6.3	28.00
148	8.40	0.20	8.2	28.00

CONVERSION

As indicated in last month's Nuexco Report, the secondary market for conversion services is being dominated by inventory holders wishing to sell material in the form of UF_6. Since most buyers are interested in purchasing uranium in the form of concentrates, these inventory holders are offering low prices on conversion services in order to "deconvert" the UF_6 inventories. Nuexco is currently seeing inventory holders making offers to sell spot conversion services at prices in the range of \$1.00 per pound U as UF_6.

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COMMENTARY

NUCLEAR POWER AND THE NEW POLITICAL ENVIRONMENT

by J. R. Wolcott*

The 1980 elections are over. We now know that Mr. Reagan will be President. We will have a Republican controlled Senate and a Democratic controlled House of Representatives. President-elect Reagan's position is expected to be firmer than President Carter's equivocal classification of nuclear as a "last resort." The more conservative Congress will tilt to a concern with what is *practical*, and less with what is only *theoretically* desirable.

Frequently asked questions are: "How soon will President Reagan turn the situation around?" "How soon will we see a resurgence of new plant orders?" and "How soon will this impact upon the uranium business?" Questions of that type are the main subject of my comments today.

I should comment at the outset that my view is generally that of a short range pessimist and a long term optimist. The near term problems I foresee are too deep-seated for a quick turnaround. On the other hand, we do have a better political climate which may allow for actions beneficial in the long term.

We have to bear in mind the many problems facing the forthcoming administration. The counter forces remain, even if their White House influence is not as great. The President will have to allocate much of his attention to problems requiring solution now—taxes, inflation, overregulation, unemployment, defense and so on.

The first specific problem the government must come to grips with involves risks to private investors where those risks originate with government itself. A referendum was held in Maine this year. Forty percent of the voters favored a shut-down of the state's only operating nuclear power plant. Three presidential aspirants—Anderson, Brown and Kennedy—conducted anti-nuclear campaigns. Political pundits predict all three candidates will be back in 1984. This is not a climate which spawns enthusiastic investors.

A two-unit nuclear power station requires the investment of four to five billion dollars. That is more than the total value of the common equity of many major companies including Bank of America, Bell Telephone of Canada, and International Telephone & Telegraph. Investments of that magnitude are taken especially seriously when political whim is important.

A nuclear project started this year would accumulate several hundred million dollars in expenditures by 1984. Uncertainty would not end there. A project requires ten years for completion, and plant operations span 40 to 50 years. A dozen political changes are to be expected. Any one could be fatal from an investor's point of view.

If you were an utility director, you would think carefully about uncertainties for shareholders. The prudent utility course is usually the low risk course. Under today's conditions, nuclear power is not the low risk course.

Making nuclear power an attractive investment therefore requires reducing financial risks associated with political risks to acceptable levels. Only government can protect from the consequences of government. And moreover, Congressional action is required; the President cannot act alone. Congressional action requires time.

The second major obstacle is utility financing. Even assuming the political risk problem is solved, financial hurdles remain. Any utility using replacement type cost accounting would almost certainly show that it is actually liquidating, rather than generating, the capital needed to finance tomorrow's business. The capital shortage is further aggravated by government and public utility commission pressures to channel resources into capital intensive, low revenue producing systems, such as windmills, interest-free loans for insulation, and similar measures. Utility projects already committed will require more than 50 billion dollars per year during the 1980's.

A third major problem is reorganization of the whole nuclear power industry. Will an industry that took shape in the 1950's, was essentially eclipsed in 1975, and has become embroiled in political controversy ever since, re-emerge in the old conceptual framework? I do not think so. Major structural changes are likely in every facet of the business—site location, forms of ownership, financing, industry roles, government roles, technical relationships, reg-

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*This Commentary is the text of an address by J. R. Wolcott, President, Nuexco, at the Nuexco Luncheon, Atomic Industrial Forum Annual Meeting, Washington, D.C., November 17, 1980.

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COMMENTARY

ulatory approaches, and so on. The new concept is not ready. We have got to get it ready.

Recent examples illustrate the possible breadth of restructuring of the industry. People are thinking in terms unthinkable five or ten years ago. A privately-owned utility president has suggested nationalization of nuclear power generation. Another utility leader has suggested confining nuclear power plant operations responsibilities to select large utilities. The USNRC is considering site criteria limiting plant locations to areas with population densities of less than 500 persons per square mile in a 30-mile radius. This is only the tip of the iceberg.

Forces are at work which do encourage action. It obviously does not make sense to use oil to generate electricity. The entire US national power plant oil inventory may be less than ninety days' supply. Stockpiled US uranium, on the other hand, is adequate at current consumption rates for ten years.

Electricity shortages will be more of a problem. It is not clear when a high degree of visibility will emerge. The national shortage will be an accumulation of regional shortages. Some early increments can already be seen. Aluminum plants have been shut down in the Northwest. California is preparing for automatic shut-off of air conditioners. A national shortage will not appear as a single thunderclap, but as a growing aggravation.

A recognized shortage of electric generation does not necessarily guarantee constructive action. Political considerations usually split opinions along two lines. One line favors *free market mechanisms*, so that shortages are *alleviated*. The other favors *regulatory mechanisms*, so that shortages are *managed*. For example, you may have noticed that polls indicate half the population favors gasoline rationing while the other half favors allowing prices to govern. The new President is obviously ideologically committed to free-market mechanisms. The entire US public is not.

One cannot be certain of the ultimate outcome even when government does act. Mismatches between intentions and consequences abound. President Carter's "Moral Equivalent of War" turned out to be a new tax. As Pogo said, "We met the enemy and he was us." We, the enemy, received a new 200 billion dollar tax bill, not a solution to the energy policy problem.

A recent story illustrates more concretely the possible gap between intentions and results. The story, so it goes, was that our three presidential candidates were captured by revolutionaries and sentenced to execution. Reagan was first. As the firing squad prepared to fire, he yelled "Earthquake" and escaped. Congressman Anderson, a resourceful fellow, yelled, "Flood," and escaped in the chaos. Next was President Carter, who learned from examples of Reagan and Anderson. When the firing squad was ready, Carter yelled, "Fire."

I would like to add a word about our international situation. A major rebuilding job is to be done if we are to rejoin the world community, to say nothing of leading it.

I have traveled overseas on nuclear business since 1955 on more than 100 trips. I have observed a complete reversal of the US nuclear power position. The US program was initially admired and copied in almost every respect, from technology to public policy. Then we decided to forge our own rules; the world reacted and decided to forge its own. This led to policies aimed at reducing foreign dependence upon the US. One result, for example, is more reluctance to rely upon US uranium and enrichment supply.

Our technological advantage has diminished. Others are moving ahead. The Japanese, as one example, are continuing to develop. By 1990 Japan may hold the lead in the nuclear power technology just as it does today in automobiles. If so, let's remember that we did it to ourselves.

I have described major problem areas of political risk, capital shortages, industry reorganization, government realignment, and the uncertainty of government response. All have to be tackled by the Administration and Congress. The President needs help.

If I were asked for my advice to the President, it would be as follows:

First, end White House indifference to nuclear power. We cannot hold our own, much less lead the world if we view nuclear power as a "last resort."

Second, redefine the role of government to be functional, both in furthering programs already cast, and in the new government-industry structure required for expansion.

Third, take those steps the federal government can take to place utilities on a sound financial basis so that nuclear power will not be stalemated by financial obstacles once other obstacles are removed.

Fourth, obtain legislation to protect the private investor from government actions over which he has no control.

Fifth, return to a policy of "international pragmatism." Abandon the flawed policy of "moral imperialism." Return to functioning within the world community rather than pursuing a course which isolates the United States.

Sixth, establish a visible institution for waste management. Make certain this institution meets the public need for appearance as well as substance. Something along the lines of the Synfuel Corporation may be appropriate.

I do not believe even these actions, or any other government actions, would result in an immediate burst of orders for new nuclear units. It is the utilities who must finally act. Actions along the above lines, however, would lay a foundation. A "greening" of nuclear power might begin in the mid-1980's. The test of the new Administration is not whether it can convince utilities that they should proceed with nuclear power plant purchases the next year or two. That is not practical. More time is required. The real test is whether a new political alignment can be created that will result in a workable legal and regulatory foundation. Once that is done the future can develop. If that is not done the next four years, then we will enter the back half of the 1980's no closer to a solution than we are today. I would not view President Reagan's nuclear power program as a failure simply because new starts are not made within his term. I would view the program as a failure if provisions are not made on which to build for the future. The action described herein may not be as visible and impressive as we would like. Waiting is frustrating. Frustration is a fate to which we in the nuclear business seemed destined. But it is not a bad lot.

A while ago I asked one of our bright young brokers who joined us after graduating from Stanford, whether she was bothered by the political and social turmoil associated with nuclear power. Our headquarters are located, as you know, on the perimeter of the Stanford campus. "Oh, no," she said, "nuclear power is at the eye of the whole political and social storm. I wouldn't want to be anywhere else." Intuitively, I have always felt the same way. Her perspective, nevertheless, helped my morale and my patience.

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RAW MATERIALS

THE SCHWARTZWALDER MINE

Introduction

Approximately 98 percent of known uranium resources in the US occur as bedded deposits in sandstone formations primarily of Triassic, Jurassic and Tertiary Age. The remaining two percent occurs as vein deposits in older metamorphic and igneous rocks. The Schwartzwalder deposit in Colorado is the largest and most productive deposit in the latter category. The Midnight deposit located near Spokane, Washington and the Pitch deposit located near Marshall Pass, Colorado are the only other vein-type deposits currently being mined.

The Schwartzwalder is one of many uranium occurrences found along the Colorado Front Range west of Denver, Colorado. In fact, there are at least 30 known uranium occurrences along a stretch of the Front Range starting about 25 miles southwest of Denver and extending to the northwest approximately 60 miles. Of these occurrences, 13 are found in Proterozoic metasediments that make up the foothills of the Front Range. Another 14 are in Precambrian crystalline rocks that form the core of the range. The three remaining occurrences are located in Cretaceous sandstones adjacent to the metamorphic rocks. Figure 1 is a map of the Front Range showing the location of the Schwartzwalder Mine in relation to the other uranium occurrences and the Colorado Mineral Belt.

The deposits in sediments and metasediments have been mined solely for uranium. The Schwartzwalder is an exception. In crystalline rocks, uranium usually occurs in minor association with other minerals. Originally, the uranium was discarded along with waste rock during the mining process of other minerals.

The important uranium mineralization at the Schwartzwalder occurs primarily in fissure veins along faults and fractures in the metasediments and crystalline rocks. Disseminated mineralization in pegmatite dikes is of secondary importance. The main uranium minerals present are pitchblende and coffinite—both primary minerals found in the unoxidized portion of the deposits. The uranium minerals autunite, torbernite and uranophane have been mined from the oxidized zone of various deposits. Pitchblende is the main uranium mineral at the Schwartzwalder mine.

History

Most of the uranium sites noted on Figure 1 were prospected for sulfides and precious metals during the 1800's. However it was not until about 1871 that pitchblende was identified as an accessory mineral in several gold mines of the Central City mining district. Thereafter, uranium was recognized in many mines and prospects throughout the Front Range. Small quantities of uranium were produced intermittently from various mines, primarily from the Central City district.

The US Geological Survey began evaluation of all known uranium occurrences in the Front Range in the late 1940's. The presence of the Survey stimulated interest in the area. This resulted in additional discoveries and higher production by the early 1950's. The Schwartzwalder deposit was discovered in 1949 at the site of an old copper gold prospect pit. The secondary mineral torbernite was recognized in alteration cavities and fractures. Chemical assays of samples taken from the pit contained up to 0.70 percent U_3O_8. Pitchblende was later recognized as the main ore mineral present.

It was determined from early prospecting that uranium mineralization at the Schwartzwalder deposit was confined to veins in a near-vertical fault zone. The first ore mined came from small surface pits and an adit driven horizontally across the mineralized zone which proved to be several hundred feet wide. The first ore shipments were made to the Vitro Chemical mill at Salt Lake City in November 1953. Thereafter the property developed rapidly as an underground mine.

The Schwartzwalder mine was acquired by the Denver Golden Oil and Uranium Company in 1956. The Cotter Corporation acquired the property in 1965. Cotter discovered additional ore reserves and initiated a mine plan to develop the deeper ore zones along the main fault. The Cotter Corporation became a wholly-owned subsidiary of Commonwealth Edison Company in 1974. All production has been processed at Cotter's Canon City mill since 1958. Total production to date from the Schwartzwalder Mine is approximately 11.5 million pounds U_3O_8. Figure 2 is a photograph of the surface facilities at the Schwartzwalder Mine.

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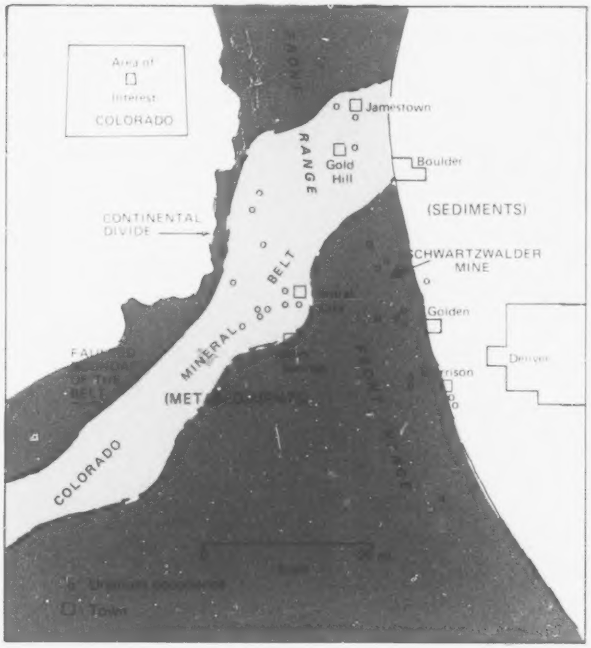

Figure 1
LOCATION MAP OF THE SCHWARTZWALDER MINE WITH RELATION TO KNOWN URANIUM OCCURRENCES AND THE COLORADO MINERAL BELT IN THE CENTRAL PART OF THE FRONT RANGE.

District Geology

Uranium mineralization in the Front Range occurs exclusively in veins within metamorphic and igneous rocks and locally disseminated in pegmatite dikes. However, the occurrences in the metamorphic rocks are of first importance economically. Uranium production from deposits in other rock types generally has been of secondary importance to other minerals and actual quantities recovered are comparatively small.

That portion of the Front Range consists almost entirely of the Idaho Springs Formation which consists of Precambrian metasedimentary and metavolcanic rocks of the Lower Proterozoic Era (2,000 to 1,800 million years in age). The Idaho Springs Formation was intruded by granitic rocks and underwent further metamorphism and structural change during Proterozoic time and again during the Larimide orogeny (late Cretaceous and early Tertiary). Numerous northwest trending faults and complex folds were created and remained active during each stage of intrusion and metamorphism.

The structural features of the metalogenic Colorado mineral belt formed at the same time. The mineral belt is separated from the northwest structural pattern of the range by a narrow northeast structural belt characterized by granitic and dike intrusions. Gold and silver deposits which formed during the Laramide orogeny have been mined throughout the extent of the mineral belt. However, no commercially important uranium deposits have been located within the limits of the belt (see Figure 1). Even so, all mineralization known in the Front Range province is nearly always associated directly with faulting and related structural features such as brecciation and fracturing. Figure 3 is a geologic and structural map of the Schwartzwalder mine area.

Mine Geology

The metasediments at the Schwartzwalder mine have been faulted and folded to form a syncline which plunges to the west. Large segments of rock along the fault zones were intensely brecciated and fractured to form "open channel ways" which allowed the passage of mineral-bearing solutions. The Schwartzwalder orebody is confined to such a breccia zone on the Rogers shear system, one of five major northwest trending structures along the Front Range. The breccia zones vary from less than one foot to complex "horsetail" zones about 1,000 feet in width. The well cemented breccia zones (ankerite and quartz are the main cementing agents) are referred to as "breccia reefs." The cementing process is considered to be the first stage of mineralization to take place along the structure. Uranium mineralization was absent during this period.

It is postulated that the breccia zones were tightly cemented during the Lower Proterozoic orogeny, only to be refractured and reopened by additional movement, probably during Middle Proterozoic and Laramide time. Uranium deposits formed where uranium-bearing solutions flooded the reopened breccia zones. There is evidence in the mine suggesting that early uranium deposits may have experienced a certain amount of remobilization and that uranium was redeposited during a later phase of the Laramide mineralizing process.

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RAW MATERIALS

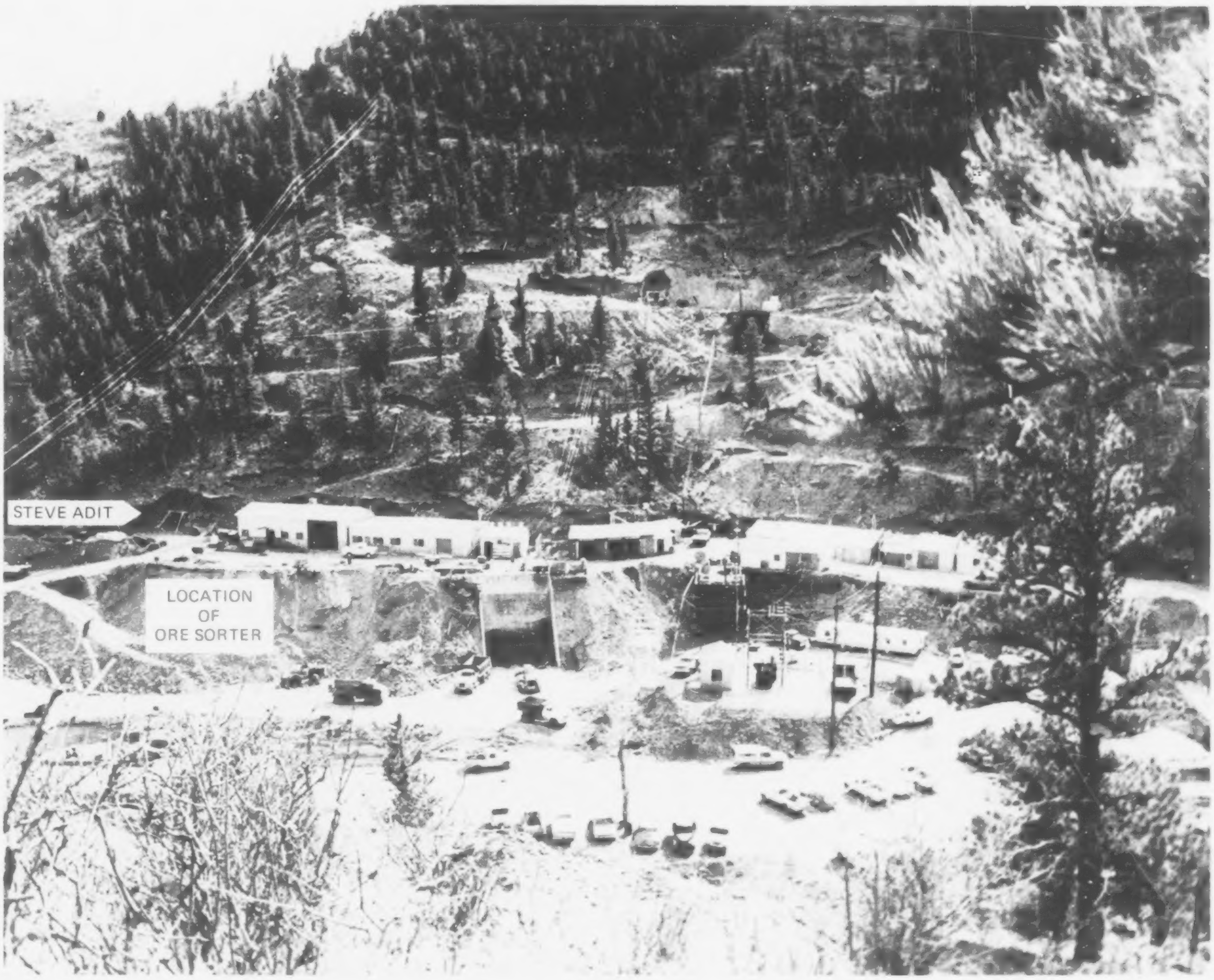
STEVE ADIT
LOCATION OF ORE SORTER

Figure 2
SURFACE FACILITIES AT THE SCHWARTZWALDER MINE.

RAW MATERIALS

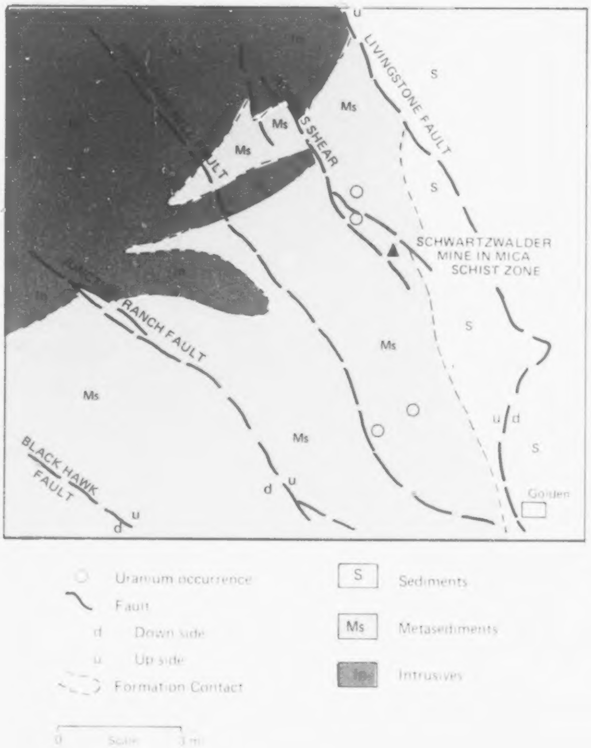

Figure 3
GEOLOGIC AND STRUCTURAL MAP OF THE SCHWARTZWALDER MINE AREA.

Pitchblende is the dominant ore mineral and is deposited as rich veins in the open spaces of intensely fractured breccia along fault planes and intersections in the complex fault system. The main ore zones occur along the hangingwall of the westerly dipping Illinois fault which is a segment of the Rogers shear system, and associated hangingwall faults forming "horsetail" vein patterns that dip easterly into the Illinois fault. Figure 4 is an east-west vertical section through the mine showing the present mine workings with relation to the structural configuration of the deposit. Ore deposition is completely controlled by the Illinois and related structures.

The important host rocks for the ore are garnet-biotite gneiss, quartz-biotite schist and massive quartzite. Vein-filling quartzite and pegmatite dikes occasionally carry ore values in certain parts of the mine. However, the quartz-biotite schist is by far the most important host. An estimated 70 percent of the ore occurs in the east dipping horsetail veins; the remainder occurs along the steeper Illinois and related faults (see figure 4).

The important accumulation of uranium at the Schwartzwalder deposit and other Front Range deposits, probably took place during the Laramide orogeny. If so, the age of mineralization is 70 to 60 million years. The mode of accumulation is considered to be hydrothermal—i.e., uraniferous hot waters ascended along the open faults from great depths to deposit the uranium in the open spaces within the favored host rock.

Mining Procedures

Initial mine development consisted of driving five adits into the outcrop area of the Illinois fault. The three upper adits were intended more for exploration than mining and each was soon abandoned. However, the two lower adits were driven straight into the breccia zone for a distance of almost 700 feet. The Steve adit remains as the main access to the lower mine workings.

The mine has been developed to the 19th level below the Steve level, a depth of 2,000 feet. The Steve level is joined to the 8th level by the No. 1 shaft, and to the 11th level by the No. 2 shaft. An 8-foot diameter raise bore hole was drilled about 1,100 feet west of the mine to exhaust the lower mine levels (see Figure 4).

The principal vein structures are designated by names, letters and numbers in order to record ore type and grade, and mining progress. The main vein is along the Illinois fault which bifurcates to form the Washington fault from the 7th level to the surface and develops into a rich vein segment from the 11th level to below the 19th level. The horsetail veins extend upward from the Illinois at an angle of 30 to 70 degrees. The important vein configurations are shown on Figure 4.

Mining methods depend upon the characteristics of each vein. Throughout the upper levels in the more gently dipping horsetail veins, the ore is prepared for blasting by conventional jackleg drilling. The broken ore is moved by slushers, trackless loaders and Youngbuggies. The steeper veins are mined by shrink stope methods using jacklegs and stopers. The broken ore (and waste) must be transferred at least twice from the lower levels to the surface. The transfer is made by utilizing one yard front end loaders.

BEST AVAILABLE COPY

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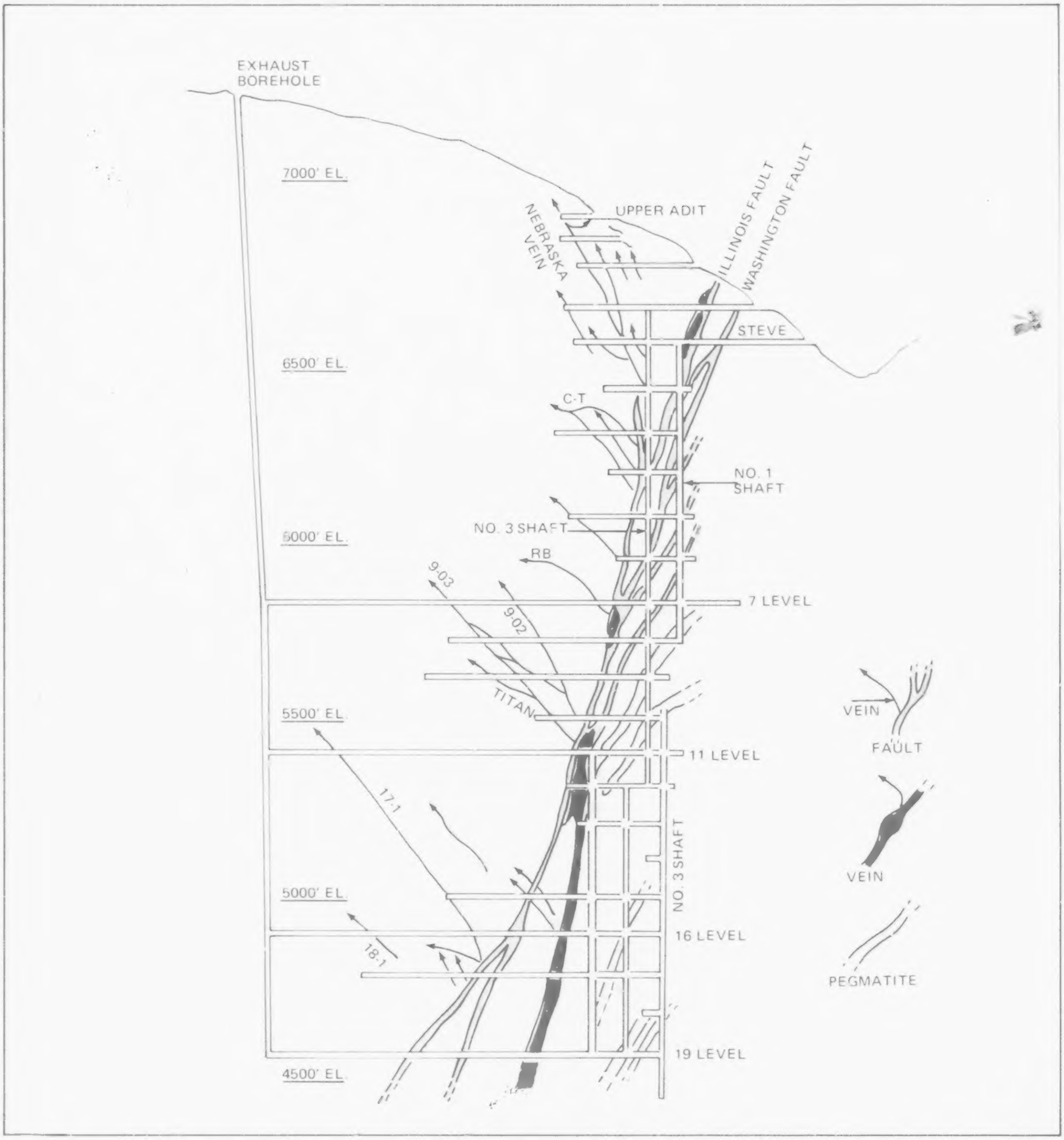
EXHAUST BOREHOLE
7000' EL.
UPPER ADIT
NEBRASKA VEIN
ILLINOIS FAULT
WASHINGTON FAULT
STEVE
6500' EL.
C-T
NO. 1 SHAFT
NO. 3 SHAFT
6000' EL.
RB
9-03
9-02
7 LEVEL
TITAN
5500' EL.
11 LEVEL
17-1
VEIN
FAULT
NO. 3 SHAFT
VEIN
5000' EL.
16 LEVEL
18-1
PEGMATITE
19 LEVEL
4500' EL.

Figure 4

VERTICAL SECTION THROUGH THE SCHWARTZWALDER MINE WORKINGS, JANUARY, 1980, SHOWING RELATIONSHIP OF THE HORSETAIL VEIN STRUCTURES TO THE ILLINOIS FAULT

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RAW MATERIALS

Cotter Corporation has devised a special technique for upgrading the ore after it is delivered to the surface. An electronic analyzer has been put into service to improve the grade of ore to be shipped to the mill. The analyzer is properly referred to as an "ore sorter." Figure 5 is a photograph of the ore sorter building and conveyor belt system which delivers all mined ore through the sorter after it has been crushed, washed and sized to 1-3 inches. The washed fines are automatically delivered to the ore stockpile. The function of the sorter is to analyze each rock fragment photometrically and radiometrically. Rock fragments that fit within optimum mass and radioactivity parameters, are air-blasted off the traveling belt onto an ore pile. Any fragments remaining on the belt drop onto a waste pile. The sorter is preset to optimize ore grade by discriminating against low grade material. It effectively operates at a 30 percent reject rate sorting out rock of 0.02 percent U_3O_8 or less. The sorter was installed in 1976 and it has been extremely effective in producing a net saving to Cotter Corporation relative to a direct reduction in the amount of ore transported and milled at the Canon City mill.

After the ore has passed through the sorter, it is stockpiled at a site four miles from the mine for later shipment to the Cotter mill at Canon City, 145 miles to the south. The expanded Cotter mill began operation in September 1979. Mill capacity is 1,200 tons per day. About 100 tons of Schwartzwalder ore are processed per day to produce an estimated 100,000 pounds U_3O_8 annually. Remaining mill capacity is supplied from the Cotter properties located in the Utah-Colorado area of the Colorado Plateau district.

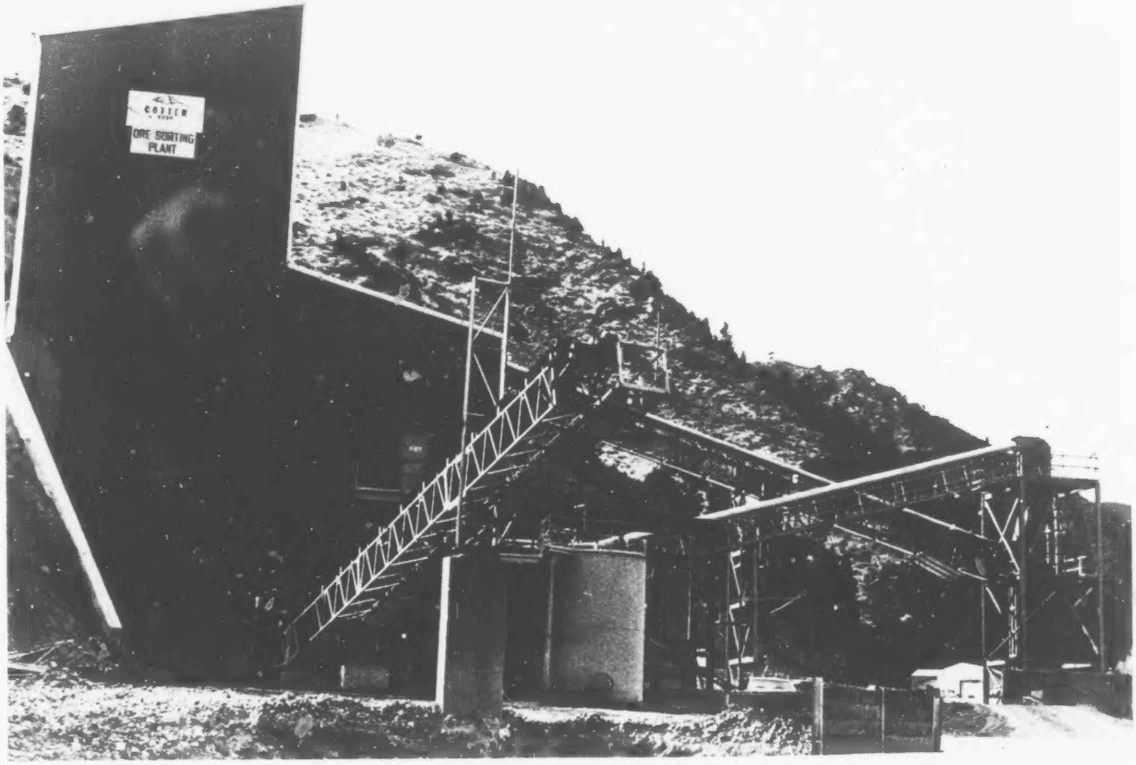

Figure 5
ORE SORTER BUILDING AT SCHWARTZWALDER MINE.

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STATISTICAL DATA

EXCHANGE VALUE—$28.00/lb U_3O_8
Determined as of November 30, 1980

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of November 30, 1980

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
28.70	2.9	16	4

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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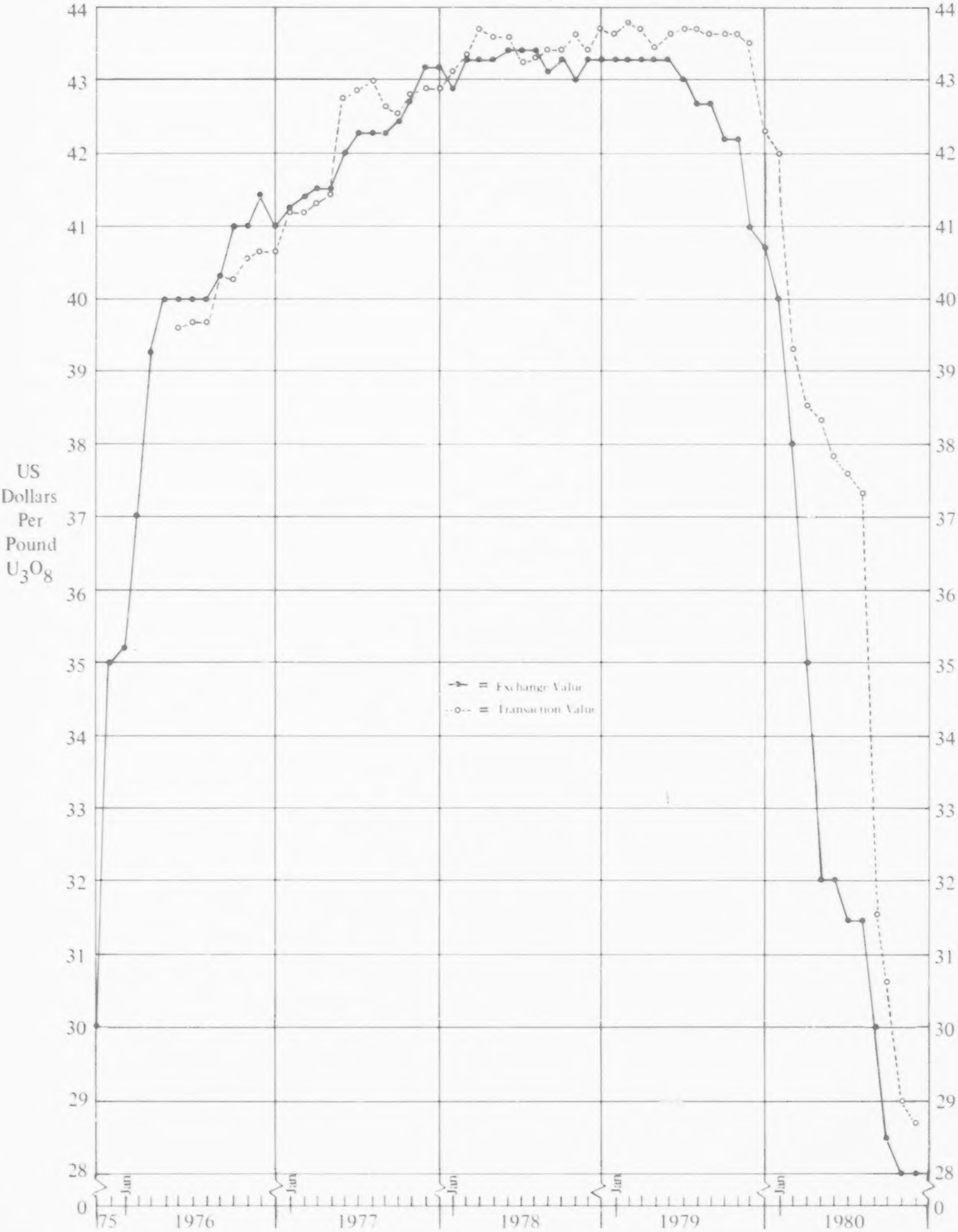
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES
SINCE NOVEMBER 1975

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated
(US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	

Note: See earlier Nuexco Reports for evolution of the definition of Exchange Value.

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated
(US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	

Note: See Nuexco Report 135 for a discussion of the definition of Transaction Value.

STATISTICAL DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	28.00	61.73	72.79
France (franc)	124.28	273.99	323.10
FRG (mark)	53.51	117.96	139.11
Japan (yen)	5,994	13,215	15,584
Switzerland (franc)	46.69	102.93	121.38
UK (pound)	11.84	26.11	30.79
Australia (dollar)	24.01	52.94	62.43
Canada (dollar)	33.30	73.41	86.57
Niger, Gabon (CFA)	6,214	13,699	16,155
South Africa (rand)	21.02	46.34	54.65

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

LOAN USE CHARGE RATE—7.0% year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.
B. Rates included in firm proposals to borrow or lend.
C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
1279	81	101 – 300	102	US	US	
1287	81	101 – 300	100	US	US	
1288	81	101 – 300	100	Europe	Europe	

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*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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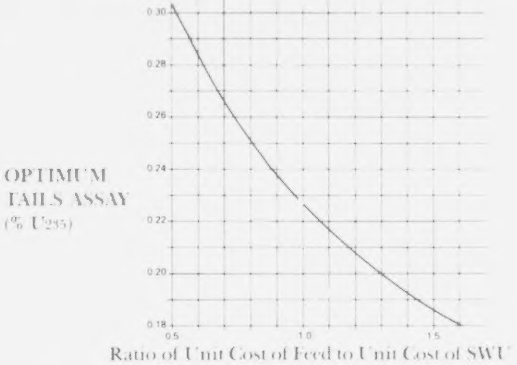
STATISTICAL DATA

OPTIMUM TAILS ASSAY

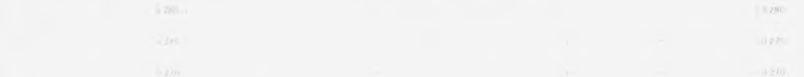
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF$_6$ to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U$_{235}$. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]		
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970 (5)	110.0	116.3	91.36	3.88	3.87	3.69
Annual Avg. 1971 (5)	114.1	121.3	96.02	4.12	4.15	3.97
Annual Avg. 1972 (5)	117.9	125.3	100.00	4.56	4.59	4.26
Annual Avg. 1973 (5)	125.9	133.1	105.80	4.84	4.98	4.51
Annual Avg. 1974 (5)	153.8	147.7	116.02	5.44	5.63	4.88
Annual Avg. 1975 (5)	171.5	161.2	127.15	6.13	6.24	5.39
Annual Avg. 1976 (5)	182.4	170.5	133.71	6.76	6.87	5.91
Annual Avg. 1977 (6)	195.1	181.5	141.70	7.28	7.67	6.43
Annual Avg. 1978 (6)	209.4	195.4	152.05	8.23	8.56	7.02
Annual Avg. 1979 (6)	236.5	217.4	165.46	9.27	9.49	7.60
Aug 1979	240.6	221.1	—	9.38	9.70	7.66
Sep 1979	244.2	223.4	167.20	9.63	9.79	7.74
Oct 1979	249.0	225.4	—	9.67	9.87	7.83
Nov 1979	250.6	227.5	—	9.78	9.85	7.88
Dec 1979	253.1	229.9	170.58	9.80	9.92	7.92
Jan 1980	260.6	233.2	—	9.91	10.06	7.97
Feb 1980	265.9	236.4	—	9.92	10.01	8.01
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05
Apr 1980	271.3R	242.5	—	10.00	10.30	8.12
May 1980	272.9R	244.9R	—	10.18	10.37	8.17
Jun 1980	273.5R	247.6	178.93	10.13	10.69	8.24
Jul 1980	275.6	247.8	—	10.24	10.82	8.35
Aug 1980	277.3	249.4	—	10.38	10.78	8.39
Sep 1980	278.2P	251.7	182.92	10.49P	10.90P	8.44P
Oct 1980	281.2P	253.9	—	—	—	8.52P

P = Preliminary   R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Data for 1970-1976, monthly except for the GNP Implicit Price Deflator, and Price Index data for 1977-1978 appear on pages 16-18 of Nuexco Report 139.

(6) Employment and Earnings data for 1977-1979, monthly, appear on page 33 of Nuexco Report 147.

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AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	215.4	190.04
Annual Avg. 1979	248.5	196.34
Jun 1979	294.9	196.65
Jul 1979	298.2	199.22
Aug 1979	293.2	200.29
Sep 1979	302.4	201.10R
Oct 1979	309.4	200.56R
Nov 1979	310.4	199.91R
Dec 1979	319.4	200.71R
Jan 1980	340.1	215.75R
Feb 1980	345.6	215.18R
Mar 1980	340.3	214.81R
Apr 1980	327.9	215.12R
May 1980	335.1	214.71R
Jun 1980	338.4	214.04R
Jul 1980	349.1	221.34
Aug 1980	353.2P	219.62P
Sep 1980	351.7P	218.98P

P = Preliminary   R = Revised since last month

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	**Primary Metal Industries, non-ferrous (SIC 296-298)**	**Chemicals and Chemical Products (SIC 370-379)**
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Jul 1979	218.3	9.37	7.34	7.73
Aug 1979	220.0	9.56	7.38	7.77
Sep 1979	223.4	9.75	7.50	7.81
Oct 1979	227.4	9.89	7.54	7.88
Nov 1979	228.1	9.97	7.61	7.91
Dec 1979	230.4	9.93	7.51	7.89
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.0R	10.40	7.94	8.36
May 1980	242.4R	10.50	8.01	8.44
Jun 1980	243.7R	10.51	8.07	8.46
Jul 1980	246.2R	10.49P	8.11P	8.55P
Aug 1980	249.2	10.59P	8.17P	8.62P
Sep 1980	251.5P	—	—	—

P = Preliminary   R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)
Annual Avg. 1970(3)	7.34	100.3(4)
Annual Avg. 1971(3)	7.88	106.4(4)
Annual Avg. 1972(3)	8.79	113.3(4)
Annual Avg. 1973(3)	10.51	124.1(4)
Annual Avg. 1974(3)	13.18	138.5(4)
Annual Avg. 1975(3)	16.71	157.2(4)
Annual Avg. 1976(3)	19.30	174.7(4)
Annual Avg. 1977(3)	23.87	194.4(4)
Annual Avg. 1978(3)	27.14	137.2
Annual Avg. 1979(3)	30.18	155.3
Aug 1979	–	160.2
Sep 1979	30.71	162.1
Oct 1979	–	162.9
Nov 1979	–	163.4
Dec 1979	31.89	164.0
Jan 1980	–	165.4
Feb 1980	–	167.0
Mar 1980	33.65	168.0
Apr 1980	–	170.0
May 1980	–	171.9
Jun 1980	34.48R	174.6
Jul 1980	–	177.2
Aug 1980	–	179.2
Sep 1980	36.19	182.8
Oct 1980	–	186.3

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(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.

(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."

(3) Historical data for 1970 through 1979 appear on page 4.9 of Nuexco Report 140.

(4) April 1970 = 100.00

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1286	150	150	150	Long term
1392	200			
1394	1000			UF_6
1475	1000			UF_6
1480	500			
1481	250			
1490	1250			
1496	350			
1533	400			UF_6
1534	800			
1540	750			UF_6
1547	100			
1550	1000			UF_6
1551	150			
1552	200			
1559	300			
TOTALS	8400			
Available for Loan:				
1355	600			
1429	500			
1492	900			UF_6
1520	1000			UF_6
1531	500			UF_6
TOTAL	3500			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1459		200	200	Long term
1462			100	Long term
1488		100		
1489	200			
1529			550	Long term
TOTALS	200	300	850	
Inquiries to Borrow:				
1553	900			
TOTAL	900			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1394	850			
1450	850			
1451	150			
1475	850			
1533	350			
1540	650			
TOTAL	3700			

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1488		100		
1556	850			
TOTALS	850	100		

*Measured from the date of this Report.

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INDEX

URANIUM MARKET INDEX

Topic	Report Number 136	137	138	139	140	141	142	143	144	145	146	147
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Monthly Report on the Uranium Market

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MONTHLY REPORT ON THE URANIUM MARKET

January 1981 No. 149

JAMES E. VAUGHAN, *EDITOR*

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FOREWORD

We are happy to announce that Teresa T. Elms has joined the Nuexco staff as an Associate. Terry came to Nuexco from Pan American World Airways where she was a Language Coordinator. Terry is a graduate of Stanford University where she majored in East Asian Studies.

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URANIUM MARKET

GENERAL

In Report 147, Nuexco presented a forecast of Apparent Future Consumption, and discussed the assumptions underlying the forecast. Several subscribers questioned whether the rate of reduction in uranium requirements due to nuclear physics improvements was too fast, and whether the forecast improvements in fuel exposure were too aggressive.

Subscriber concern arose over an unclear statement in that Report: "More efficient fuel design is expected to lead to an overall reduction in uranium consumption of approximately 15 percent between 1981 and 1985 and another 15 percent between 1985 and 1990." What should have been said was that the INFCE[1] studies discuss improvements of 15 and 30 percent for LWR plants, but Nuexco used a much more conservative basis for physics improvements in the consumption forecast published in Report 147. A comparison between INFCE improvements and Nuexco assumptions is shown in Table 1.

More specifically, the INFCE report discusses nine methods for improving uranium utilization in LWR plants:

1. Increased burnup (MWD/MTU)
2. Lattice changes
3. Spectrum shift
4. Enrichment zoning, including blankets
5. Full use of early batches of startup core
6. Improved fuel management and control design
7. End-of-cycle coastdown
8. Reconstitution inversion of BWR fuel
9. Increased frequency of refueling

The INFCE report states that

> *. . . some of these improvements are likely to be relatively easily demonstrated; others are expected to be more difficult and require additional time and resources. Each improvement category has been considered separately even though most of the improvements are interrelated, and therefore their contributions to a cumulative reduction in uranium requirements would not be additive . . .*
>
> *It is estimated that measures which could lead to savings of 10 to 15% in uranium utilization without undue economic or safety consequences could be demonstrated during the next decade, provided the necessary development programmes are successful.*
>
> *In the course of further development, additional savings might be demonstrated; some countries estimated another 15% savings to be achievable, whereas others were less confident that such savings are possible.*

Nuexco recognized that these improvement targets had to be discounted in terms of general application to LWR plants. Thus Nuexco selected improvements in uranium utilization of 3.4 percent by 1985 and 9.7 percent by 1990, as shown in Table 1.

INFCE also noted that "one of the more attractive means of improving uranium utilization in the once-through mode would be to increase the discharge burnup." INFCE then discussed reductions in uranium requirements arising from increased fuel ex-

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[1] International Nuclear Fuel Cycle Evaluation, International Atomic Energy Agency, Vienna, 1980: Volume 8, Advanced Fuel Cycle and Reactor Concepts, Report of INFCE Working Group 8, pages 53-67.

Table 1

COMPARISON OF THIRTY YEAR URANIUM REQUIREMENTS (MTU/GWe) FOR PWR PLANTS OF CURRENT AND IMPROVED DESIGN BETWEEN INFCE[1] AND NUEXCO[2]

		Nuexco Assumption for Plants Operating in:		INFCE Improved Design Leading to Uranium Savings of:	
	Current Design	**1985**	**1990**	**15%**	**30%**
INFCE[1] (MTU/GWe)	4,350			3,700	3,040
Nuexco[2] (MTU/GWe)	4,350	4,200	3,930		
Relative Improvement (%)	Base	3.4	9.7	15	30

[1] Adapted from Table V (page 67) of INFCE Volume 8.

[2] Nuexco data normalized to INFCE conditions.

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posure ranging from 5 to 12 percent and presented tabular data on fuel cycle information for several of these cases. These cases, supported by further detail in the NASAP studies[2] of the same cases, provided Nuexco with consistent sets of physics data for modest improvements in uranium utilization. Thus, Nuexco's assumption of modest improvements in uranium utilization were achieved wholly by increasing fuel exposure and essentially discounted the other eight areas of fuel improvement potential.

A similar approach was followed for heavy water reactor plants where modest improvements in uranium utilization were assumed by 1985, but larger gains were instituted by 1990 through the use of slightly enriched uranium (1.20 percent U_{235}) in reload fuel. For conservatism, no improvements were assumed for gas-cooled reactor plants.

AUSTRALIA

After a decade of uncertainty and political and public debate, 1980 saw Australia emerge as a significant new force in the uranium production industry. Political and related problems were such that Australia was unable to enter the market when it was at its strongest. The necessity of marketing in a declining market was difficult and time consuming and resulted naturally in less favorable terms and conditions than could have been obtained earlier. Nevertheless, buyers were eager to have Australia in the market as a competitor to the other major exporting countries, and consequently were prepared to agree to terms they were unwilling to grant sellers in other countries. Major developments involving approved projects include:

1. Queensland Mines' Nabarlek facility was successfully commissioned in mid-year, and the initial export shipment occurred in November. Marketing is proceeding with some long-term contracts signed and others in various stages of negotiation.

2. The Ranger project made enormous strides. Peko Wallsend and Electrolytic Zinc arranged the repurchase of the government's 50 percent share of the project and the launching of a new corporate entity, Energy Resources of Australia (ERA) to own and manage the project. Substantially all the production, rated at 6.6 million pounds U_3O_8 annually, has been committed through 1996. Development of the mine and mill complex is on schedule, with production to begin in late 1981.

3. Western Mining's Yeelirrie project continued to move forward, with the completion of a pilot plant at Kalgoorie to test the metallurgy circuits on a continuous basis. Production is anticipated in late 1985.

4. Mary Kathleen continued operations, at the rate of about 1.8 million pounds U_3O_8 annually, and is investigating additional uranium investments because reserves at the current mine will be exhausted by the end of 1984.

The outlook for a number of other projects will depend on market developments in the coming years as well as the posture adopted by the Australian government as international competition increases.

1. Denison Mines of Canada purchased the Koongarra deposit from Noranda, also a Canadian company, and is seeking the necessary approvals with a view towards beginning site development in 1981.

2. Pancontinental continued its efforts to gain aboriginal agreement and other approvals necessary to develop its enormous Jabiluka deposit.

Roxby Downs, Beverly, Honeymoon, Lake Way, and a number of other potential developments continued to move forward, but the timing of these projects remains market dependent.

AFRICA

The Chairman of South Africa's Rand Mines Ltd. observed in his annual statement to shareholders that the two Rand Mines uranium producers, Harmony and Blyvooruitzicht, have sold most of their production under long term contracts, but that "any excess will be stockpiled awaiting the considerable improvement in prices that is expected in the years to come." His statement follows a similar announcement regarding stockpiling by Anglo American Corp., South Africa's largest uranium producer.

In the 1980 report to shareholders, the chairman of Anglo American's Orange Free State gold mining companies announced in connection with the Joint Metallurgical Scheme (JMS) that total JMS uranium profits fell from about R43 million in 1979 to about R18.5 million in 1980. The decrease was due primarily to the weakening spot market for uranium and

---

[2] Nuclear Proliferation and Civilian Nuclear Power: Report of the Nonproliferation Alternative System Assessment Program, Volume IX: Reactor and Fuel Cycle Descriptions, DOE, December 1979.

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the suspension of uranium deliveries to the Atomic Energy Organization of Iran.

CANADA

Optimism for the long term continued for Canadian uranium producers during 1980 although a distinct near term slowdown was apparent. As in other countries the many facets of energy, its development and use are of primary concern in Canada. The recently published Canadian federal budget has focused attention on the energy issue because the federal government continues to impose price controls on Canadian oil producers in the western provinces, while subsidizing imported oil for the eastern provinces. The effect has been divisive, with the western provinces holding that the federal controls strike at the basic right of the provinces to control their own resources. Another effect of the federal budget is the slowdown of large western oil projects, which is expected in turn to have a negative impact on all sectors of the Canadian economy.

The cutback in western oil projects, combined with a mild summer and sharp drops in the Michigan and Ontario auto industries have resulted in lower than expected load growth for Ontario Hydro. This could lead to a stretchout in the construction schedule for Hydro's Darlington nuclear station. The four Darlington 850 MWe units are currently scheduled for startup in the 1989-1991 time frame.

At Elliot Lake, 1980 saw both Denison and Rio Algom continue their expansion programs, Denison toward an annual production goal of about six million pounds U_3O_8 by 1985 and Rio to a goal of about eight million pounds U_3O_8 per year by 1984.

In Saskatchewan, Amok started mining at Cluff Lake during the summer of 1980. Mill completion is expected in early 1981, and planned annual production is 4.4 million pounds U_3O_8. Eldorado continues to produce at Beaverlodge at an annual rate of one million pounds U_3O_8, and Gulf and Uranerz continue to operate Rabbit Lake and an annual rate of about five million pounds U_3O_8. Public hearings on the Key Lake project continued into the latter part of 1980. Production is anticipated by the Key Lake owners (Saskatchewan Mining Development Corp., Uranerz, and Eldorado) to begin in late 1983. The planned rate of production is at least eight million pounds U_3O_8 annually, and could be increased to as much as 12 million pounds.

The government policy in Saskatchewan is stated to ensure that products from established mines are marketed prior to approval of further expansions by scheduling the rate at which new deposits are developed. The government has also developed royalties and taxes to maximize returns to the province.

EUROPE

Nuclear power stations are "no more, and probably less" of a risk to the public than power stations burning coal or oil, says a report from the Health and Safety Executive (HSE) of England. The HSE reached this conclusion after examining the published scientific information on accidents and other associated dangers of the three basic systems for generating electricity. The HSE is primarily responsible for the health and safety of workers in England.

During the Swiss hydrological year of October 1979 through September 1980, the total share of electrical generation from nuclear power was 26.5 percent. This was an increase of about 18 percent over the previous year, and resulted from the startup of the Goesgen plant.

FAR EAST

The Japanese government recently adopted an official target for non-oil energy supplies, designed to reduce reliance on imported oil from the present 73 percent to 50 percent by 1990. As a part of this plan, it is intended that nuclear generating capacity will be increased from the current 15,000 MWe to between 51,000 and 53,000 MWe by 1990.

Japan currently has 21 nuclear power plants on line. To achieve the 1990 goal will require an increase to 55 to 60 plants. Of the 34 to 39 new plants required seven units representing 5,700 MWe are currently under construction with start-ups scheduled between early 1981 and late 1984. Six additional units, representing 5,900 MWe, have passed the necessary safety and licensing reviews by the cognizant regulatory agencies. These plants are scheduled for start-up in the 1985-1986 period. In addition, preliminary engineering and licensing work has been initiated on six other units, representing nearly 6,000 MWe, for

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completion later in the 1980's.

To achieve its goal, the Japanese will have to bring on line an average of almost four plants annually during this decade. While not impossible, based on a past history of siting and licensing difficulties, this target must be viewed as very optimistic.

UNITED STATES

The Reagan Administration will be faced with many serious problems in its effort to expand nuclear electrical supply capabilities. Utilities are in need of favorable regulatory actions and rate structures, and steps need to be taken to reduce the licensing time for nuclear power plants. These issues are discussed in detail in the *Commentary* section of this Report.

Atlas Minerals Corp. has recently begun mining its newest producer, the Velvet Mine, located about 50 miles southeast of the Atlas Mill near Moab, Utah. Access to the orebody is through a 3,400 foot long decline. Most of the development of the ore body is complete. The ore body is expected to average over 15 pounds U_3O_8 per ton of ore, and contains an estimated six million pounds U_3O_8. It is one of the highest grade deposits to be found in the US in recent years.

The Atlas mill is shown in Figure 1. It is licensed to operate at 1,600 tons ore per day, and consists of two circuits, an acid-leach circuit which recovers uranium and vanadium, and an alkaline-leach circuit which can recover uranium and copper. Design uranium recovery capacity is about 1.8 million pounds U_3O_8 annually, but recent production has been well below this.

A number of US utilities have recently found themselves unable to raise capital in both the equity and debt markets. Several utilities withdrew bond offerings during the past month because of high interest rates, inability to secure long maturity periods, or lack of interest among investors. Similar

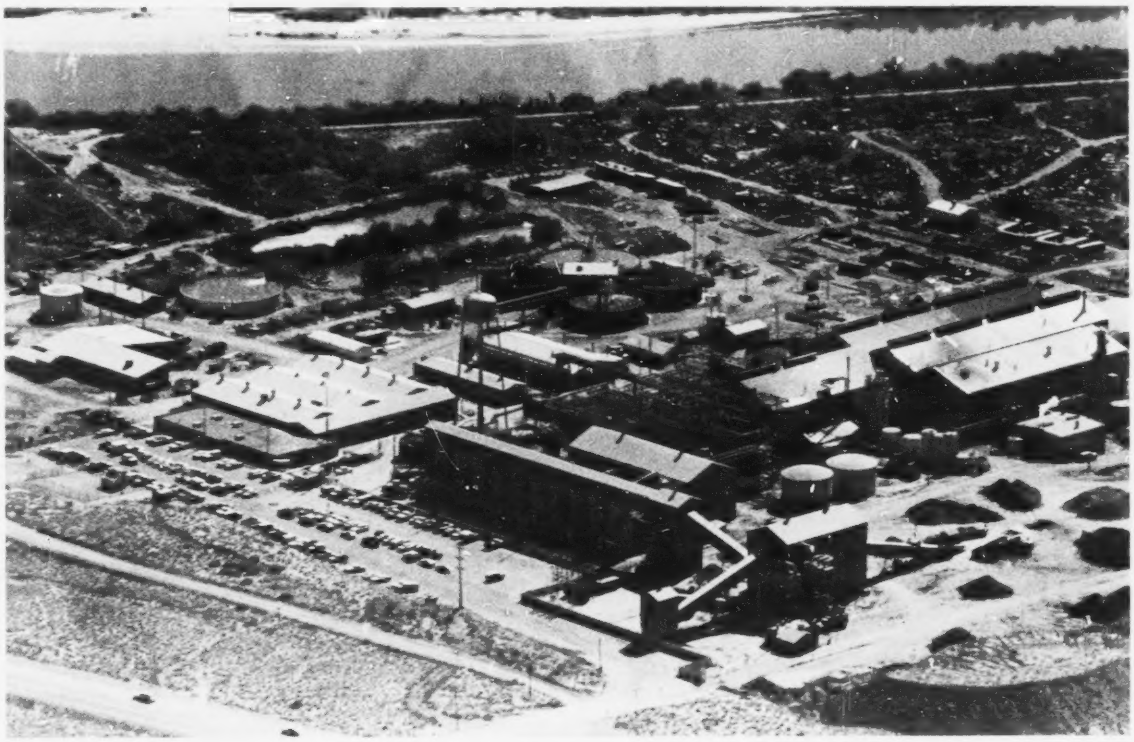

Figure 1
AERIAL VIEW OF THE ATLAS MINERALS MILL, MOAB, UTAH

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conditions have been experienced by US utilities seeking to sell new equity. The recent disarray in the securities markets may add to the financial problems faced by many US utilities. Such conditions, if long continued, could result in the further slippage of nuclear power projects due to money shortages.

TRANSACTIONS

There were two transactions reported this month. Both of them involve short term sales from US producers to US producers; one for between 301,000 and 600,000 pounds U_3O_8, and one for less than 50,000 pounds. The smaller quantity was delivered in December, while deliveries on the larger quantity will extend into 1981.

PRICING

The Exchange Value dropped this month to $27.00 from $28.00 last month. As periodically happens, a spread of two to three dollars per pound between bid and offer price levels has developed with little evidence of compromise on either side. As a result, few transactions have taken place.

It has been customary in years past to see some activity by sellers in December to book sales for the ending calendar year; there was no indication this year that that was a factor. Perhaps it was because the last minute discretionary production that might normally be available was not produced at all due to the low spot market price.

It is nevertheless clear that prices are significantly softer than they were the previous month. The transactions that did take place were at lower prices than the previous month's Exchange Value. Offers to sell have also declined somewhat. However, the limited interest in purchasing was in the $25 per pound range. Material in significant quantities could not be purchased at that level as of the end of December since sellers were not willing to reduce prices that much.

The total of active inquiries to sell in 1981, listed in the Market Opportunities section of this Report is about 7.5 million pounds U_3O_8 equivalent, while the total of active inquiries to purchase is only 200,000 pounds. Of the total available for sale in 1981, approximately seventy percent involves inventory sellers. The influence of inventory sellers continues to put downward pressure on the market. Additional downward pressure can be expected just as a result of the very large imbalance of supply vs. demand.

CONVERSION

The amount of conversion services available on the secondary market decreased to about 1.6 million pounds U in UF_6. Several offers were withdrawn, some because the sellers were involved in conversion transactions which either closed or are near closing. In two of these transactions, UF_6 inventory holders are deconverting their material in order to respond to inquiries to purchase U_3O_8.

Based on transactions that have closed recently, or are in negotiation, and current bids and offers, it now appears that spot conversion transactions on the secondary market could be completed in the near term at a price of about $1.00 per pound U as UF_6.

Deconversion transactions, or secondary conversion sales, are simply swaps of uranium concentrates for UF_6. They are very simple transactions provided that the concentrates have been accepted for conversion and can be book transferred at a conversion facility. This requires that both parties involved have a clear understanding of their rights to transfer title to their material (either concentrates or UF_6). The deconversion transaction may soon become standard industry practice both to obtain spot conversion on the secondary market, and to serve as a process by which utilities and others holding inventory in the form of UF_6 can reach a market seeking to buy uranium in the form of concentrates.

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TOPICAL ESSAY

WORLD CAPTIVE URANIUM PRODUCTION

A significant portion of the world's uranium production is captive to users. The term "captive" is described in more detail below. In essence, the term refers to material which is not now and is not likely to become available for sale in the commercial uranium market. The existence of this captive production will have an important impact on the uranium market throughout the coming decade.

Table 2, entitled US Uranium Production Forecast: Captive vs. Commercial, segregates Nuexco's forecast of US uranium production into its captive and commercial components. As of 1980, captive production represents approximately 16 percent of the total US production. The proportion of US U_3O_8 production which is captive drops off to 9 percent of the total by 1990.

Table 3 shows the same breakdown for the balance of the Free World. In contrast to the United States, non-US captive production exceeds the commercial production in each year of the period.

Care should be taken in interpreting these data. Ideally, a precise definition of "captive" would make it easy to distinguish production of this type from commercial production. However, in reality, no two captive production relationships are identical, and there are many borderline cases. Consequently, in generating these data each production center was considered individually; specific judgments were made as to whether a given production center should be categorized as captive or commercial.

This somewhat ambiguous definition of captive production flows from the varied ways users have secured captive production. For example, one method of tying up production is direct ownership in which the utility actually owns the firm producing the material. An example is Commonwealth Edison's ownership of the Cotter Corporation.

Another form of captive production is equity participation in which a utility will purchase a portion of the producing property with the right to some or all of its material. Southern California Edison's relationship with Rocky Mountain Energy in the Bear Creek venture is such an arrangement.

Yet another form of captive production is one in which the utility advances money for development of a property in exchange for the right of first refusal on some or all material produced from the property, over and above the basic contract quantities. The Long Island Lighting Company relationship with Bokum Resources is such an arrangement. This form of captive production demonstrates the fine line between captive and commercial production since it is not much different from a commercial operation which has committed the bulk of its production to a single user in a contract that has prepayment terms.

A general test which was used to evaluate various production operations was to evaluate what would happen if an additional quantity of material were to be produced. If any material produced above the expected quantity were allocated to the buyer or if the buyer had the first right of refusal, then the production may be deemed to be captive.

Table 4 shows Nuexco's current forecast of total Apparent Future Consumption. Some of the consumption included in the totals of Table 4 can be offset by captive production to yield a *commercial* Apparent Future Consumption figure, but it is a fundamental premise of this analysis that the offset should be made for *individual users* only. For example, if a Swiss utility were to have captive production of one million pounds in 1983, and total consumption of two million pounds, to compute

Table 2

US URANIUM PRODUCTION FORECAST
CAPTIVE vs. COMMERCIAL
(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Captive Production	5.5	5.8	4.5	4.1	3.3	3.2	2.7	2.4	2.4	1.9	1.4
Commercial Production	28.7	23.2	22.4	22.0	20.7	17.9	16.8	16.0	14.4	14.4	14.4
TOTAL[1]	34.2	29.0	26.9	26.1	24.0	21.1	19.5	18.4	16.8	16.3	15.8

[1] Reference Report 147, Table 7.

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Table 3

URANIUM PRODUCTION FORECAST: WOCA OUTSIDE US CAPTIVE vs. COMMERCIAL

(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
COMMERCIAL											
Australia	2.8	4.8	4.8	4.8	4.8	6.0	9.0	9.0	9.0	9.0	6.0
Canada	13.3	10.4	11.6	11.4	13.2	14.0	16.0	18.0	18.4	18.4	18.4
Republic of South Africa	13.7	17.1	18.0	18.6	19.1	19.1	19.1	18.9	18.9	18.8	18.8
TOTAL COMMERCIAL	29.8	32.3	34.4	34.8	37.1	39.1	44.1	45.9	46.3	46.2	43.2
CAPTIVE											
Australia	-0-	1.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Canada	4.7	6.0	8.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Central Africa	13.1	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
France	5.4	7.4	7.7	7.8	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Namibia	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Republic of South Africa	1.7	1.8	1.8	1.8	1.8	2.2	2.6	2.6	2.6	2.6	2.6
Other Nations	1.3	1.4	1.5	2.5	2.7	3.2	3.2	3.2	3.2	3.2	3.2
TOTAL CAPTIVE	36.2	42.9	50.3	51.4	53.1	54.0	54.4	54.4	54.4	54.4	54.7
TOTAL[1]	66.0	75.2	84.7	86.2	90.2	93.1	98.5	100.3	100.7	100.6	97.9

[1] Reference Report 147, Table 8.

Table 4

APPARENT FUTURE CONSUMPTION[1]

(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
BUYER GROUP											
United States	16.7	20.9	22.9	27.1	30.4	32.8	35.5	35.1	37.6	40.4	40.3
Europe	17.2	25.6	28.9	35.4	30.8	36.3	38.0	44.9	42.4	43.3	42.7
Far East[2]	3.8	6.9	6.9	6.8	11.1	11.7	11.6	10.7	9.6	8.5	8.7
Other Free World[3]	2.7	3.1	5.1	5.9	5.1	4.6	5.9	7.5	7.2	5.6	6.1
FREE WORLD[3] TOTAL	40.4	56.5	63.8	75.2	77.4	85.4	91.0	98.2	96.8	97.8	97.8

[1] Computed quantities of U_3O_8 which would be used under the given conditions, to fabricate fuel for loading and reloading reactors operating, under construction or on order as of October 31, 1980. Compiled and computed on a reactor-by-reactor basis, quantities for each reactor are based on specific core characteristics, 0.25% tails assay, no recycling, 24-month lead time for procuring first cores and 18-month lead time for procuring each reload. Where reload schedule is not already known, these estimates assume reloads occur one year after commercial operating date and annually thereafter. Nuexco estimates of individual reactor capacity factors are used.

[2] Japan, Korea, People's Republic of China, Taiwan.

[3] Excludes Bulgaria, Czechoslovakia, German Democratic Republic, Finland (two Russian Reactors), Hungary, Poland, Romania, USSR.

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TOPICAL ESSAY

commercial Apparent Future Consumption for Europe in 1983, it would be necessary to reduce total Apparent Future Consumption by one million pounds, as a result of the Swiss utility's having that amount covered by captive sources. If another Swiss utility had captive production of two million pounds and consumption of only 500,000 pounds in 1983, Europe's Apparent Future Consumption would as a result be reduced by only 500,000 pounds in 1983 to yield *commercial* Apparent Future Consumption. In the second example, however, the excess of 1.5 million pounds would be carried forward and would be available to offset future consumption *for that utility only*. When Apparent Future Consumption for each utility has been reduced (as described above) by that utility's captive production, the result is that utility's *commercial* Apparent Future Consumption. The sum of those estimates is shown in Table 5, in which the individual utilities are grouped according to Nuexco's customary format.

A comparison of Table 4 and Table 5 shows that a significant portion of the Apparent Future Consumption in the coming decade has already been accounted for by captive production. The net impact of this is that there is an even smaller portion of demand available for those commercially oriented uranium producers. Moreover, the captive producers are generally not the lowest cost producers. Thus, the portion of demand consumed by captive production does not remove many low cost producers from commercial activities.

Table 6 analyzes the balance of uranium supply and demand which results from the commercial production and commercial consumption developed in Tables 2, 3 and 5. Inventory, in this context, refers to uranium which is or could become available for sale on the worldwide market as a result of economic factors, as opposed to considerations of national policy. For example, inventory held by Japanese users is categorized as non-commercial due to Nuexco's belief that economic motivations would be insufficient, absent a change in national policy, to induce Japanese utilities to sell their uranium inventory. On the other hand, all inventory held by US utilities is deemed to be commercial. One ruling by the Federal Energy Regulatory Commission (FERC) which might change FERC's guidelines with respect to utility accounting treatment of uranium inventory could be sufficient to cause millions of pounds of uranium inventory to flood the market. No change in US national policy would be needed.

Table 6 shows that commercial production exceeds commercial consumption during each of the next nine years. However, the excess diminishes steadily from approximately 22 million pounds in 1981 to an insignificant amount by 1987. If all of the forecast excess is absorbed into inventory, the commercial uranium inventory would increase from 250 million pounds in 1981 to 335 million pounds in 1987. Commercial consumption increases more rapidly than inventory during the same period, so relative inventory level declines from almost nine years in 1980 to 7.5 years in 1981 to a slightly declining level of approximately six years by 1985. This trend suggests that commercial producers and consumers are adjusting to expectations of a weak uranium market more rapidly than captive producers and their consumers.

TOPICAL ESSAY

Table 5

APPARENT FUTURE CONSUMPTION AS REDUCED BY CAPTIVE PRODUCTION

(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Europe	8.3	12.7	10.3	13.3	10.2	18.0	17.3	21.6	18.7	18.0	18.2
Far East	0.2	0.9	2.2	1.1	3.3	3.1	3.3	3.5	3.7	2.9	2.6
Other Nations (Other non-US WOCA)	2.4	2.7	3.5	3.3	2.3	0.9	0.9	2.1	2.9	1.2	1.9
Subtotal (non-US WOCA)	10.9	16.3	16.0	17.7	15.8	22.0	21.5	27.2	25.3	22.1	22.7
US	13.4	17.3	20.6	24.3	28.1	29.8	33.2	31.1	35.2	37.5	37.4
TOTAL (WOCA)	24.3	33.6	36.0	42.0	43.9	51.8	54.7	58.3	60.5	59.6	60.1

Table 6

COMMERCIAL URANIUM SUPPLY-DEMAND BALANCE: WOCA[1]

(millions of pounds U_3O_8)

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Commercial Production[2]	58.5	55.5	56.8	56.8	57.8	57.0	60.9	61.9	60.7	60.6	57.6
less											
Commercial Consumption[3]	24.3	33.6	36.0	42.0	43.9	51.8	54.7	58.3	60.5	59.6	60.1
equals											
Net Inventory Increase (Decrease)	34.2	21.9	20.8	14.8	13.9	5.2	6.2	3.6	0.2	1.0	(2.5)
plus											
Beginning Inventory	216.1[4]	250.3	272.2	293.0	307.8	321.7	326.9	333.1	336.7	336.9	337.9
equals											
Ending Inventory	250.3	272.2	293.0	307.8	321.7	326.9	333.1	336.7	336.9	337.9	335.4
Relative Inventory[5]	8.9	7.4	7.6	7.0	7.0	6.2	6.0	5.7	5.6	5.7	5.6

[1] World outside Communist areas.

[2] This Report, Tables 2, 3

[3] This Report, Table 5

[4] Nuexco estimate.

[5] For each year, Relative Inventory equals Beginning Inventory divided by Consumption.

COMMENTARY

THE HALBOUTY REPORT

The future of US energy policy under the new administration was given direction recently in a report by President-elect Reagan's group of energy advisors headed by Michael Halbouty.

With a call for "undoing the restrictive legislation of the past four years," the November report includes reforms and reviews on a wide range of topics ranging from oil, natural gas, nuclear power to the Department of Energy itself. The main emphasis is on creating "an open and competitive energy market that will meet the demands of our economy and the needs of our society." The move is away from government imposed controls and excessive regulations to a free market where consumers reap the rewards of competitive energy pricing and where the US gains political and economical stability by decreasing dependence on foreign oil.

The specifics of the policy presented include the decontrol of oil and gas, the opening of public lands for exploration and development, the use of scientific cost-benefit factors as a basis for environmental policy, the encouragement of research and development of new energy technologies, the building of a significant emergency petroleum reserve and a worldwide push for energy production.

To alleviate the national security problem stemming from US dependence on foreign oil, Halbouty and associates see coal taking a lead along with nuclear power. However, the severe regulatory restrictions, such as those on air quality, are choking the possibilities and the report calls for their removal.

As with coal, the report recognizes the detrimental impact of excessive regulation on the future of nuclear power, while citing its crucial role in national security and future economic growth. It charges the Carter Administration with a policy of "benign neglect" toward nuclear power resulting in a web of details crippling the US Nuclear Regulatory Commission and hampering the licensing procedures of nuclear plants in particular. Simplification of these procedures is "absolutely essential" and would emphasize the important safety matters presently tangled in the whole process while assuring implementation of the lessons learned from Three Mile Island.

The report also attacks the non-proliferation policies of the Carter Administration as "counter productive" and damaging to the domestic and export nuclear program. An important first step in the Reagan presidency would be a review of these policies.

Expedient action by state regulatory agencies is deemed critical for the financial future of utilities. The report recommends the inclusion of in-progress construction costs in the rate base, satisfactory rate structures and the retention of benefits of accelerated depreciation and investment tax credits. Speedy legislation would be implemented to coordinate and expedite decisions on major energy projects while respecting state and local rights.

To attain the desired closing of the nuclear fuel cycle, the "Halbouty policy" calls for rapid construction of away-from-reactor spent fuel storage facilities, as well as streamlining of procedures for fuel storage facilities and fuel reprocessing plants.

This outline for a Republican energy policy presents a commitment to the nuclear industry. Stating that "electrical energy generated with our vast indigenous coal and uranium resources can make a major contribution to reducing the national security threat created by our dependence on imported petroleum," the continuing role of nuclear power is seen as essential to US political and economic stability. The recommendations from Reagan's energy advisors provide the basis for strengthening this role.

The text of the Halbouty Report concerning Nuclear and Electric Power is reproduced below in its entirety.

An expanding and healthy economy requires increasing electric supply capability. In addition, obsolete oil and gas fired capacity will need to be replaced. Only coal and nuclear plants can fill this need and they are highly capital intensive.

The most serious problem the utility industry faces is achieving favorable action by state regulatory agencies including inclusion of the cost of construction work in progress in the rate base, the retention by the utilities of the intended benefits of accelerated depreciation and investment tax credits, as well as satisfactory rate structures.

Revitalization of the essential nuclear power program requires top-level national leadership which itself can substantially strengthen public support and facilitate necessary legislative changes.

The Carter Administration's policy of benign neglect toward nuclear power has left the Nuclear

COMMENTARY

Regulatory Commission (NRC) adrift without support or guidance from the White House. This situation has contributed directly to the current nuclear plant licensing quagmire. It currently takes up to twelve to fifteen years to license and construct a nuclear power plant. It is absolutely essential that NRC licensing procedures be streamlined to reduce the time between the application for a construction permit and commercial operation. Expediting the licensing process would force all regulators to separate the important from the unimportant and thus direct sufficient attention to safety matters which have currently become smothered in a morass of detail. In this process, the government must take all steps necessary to assure that the lessons learned from Three Mile Island have been implemented and that public health and safety continues to be the primary concern. Reducing the licensing time for nuclear power plants by focusing on substantive issues only will enhance safety—not compromise it—and speed the time of United States energy security.

In addition to nuclear plant licensing, licensing requirements are currently being developed for facilities important to the balance of the nuclear fuel cycle, such as away-from-reactor spent fuel storage facilities and commercial radioactive waste repositories. Licensing procedures for these facilities as well as spent fuel reprocessing plants must be equally expeditious.

To the current time, the federal government's nuclear waste disposal program has been characterized by sudden and arbitrary changes in direction, emphasis and objectives and an unwillingness to fund and begin an adequate demonstration program. The result has been the mistaken perception by the general public that technologically feasible solutions to the waste disposal issue are not within our grasp. The fact is that the difficulty has been political and institutional rather than technical. Several technologically sound waste disposal techniques are available for utilization now. To accommodate the transition period between now and the time when the nuclear fuel cycle is closed, we need rapid construction of away-from-reactor spent fuel storage facilities.

Effective policies with respect to proliferation of nuclear weapons are essential. Those of the Carter Administration have not only been counterproductive by increasing the risk but also have seriously damaged the United States' domestic and export nuclear program. An immediate review of these policies needs to be carried out especially as they affect international cooperation and institutions as well as the domestic program including nuclear fuel reprocessing and development of the breeder reactor.

Federal "fast-track" legislation is needed that avoids infringement on substantive state and local prerogatives, yet provides an effective mechanism for coordinating and expediting decisions on high priority major energy projects, including specifically coal-fired and nuclear power plants. Such legislation will also provide for expeditious judicial review of such decisions so that we, as a nation, can be about the business of building the energy security we desperately need.

We believe that electrical energy generated with our vast indigenous coal and uranium resources can make a major contribution to reducing the national security threat created by our dependence on imported petroleum and ensure that an adequate reserve of electrical energy is available to support future United States economic growth.

URANIUM IN ALKALINE ROCKS

Introduction

Alkaline igneous rocks are considered a favorable source of economic uranium deposits. Important reserves have been discovered in Greenland, Brazil, the USSR and the United States. However, mining of uranium ores in alkaline rocks has been limited primarily to the Bokan Mountain deposit located in southern Alaska. A small amount of uranium has been recovered as a by-product during the mining of other minerals from alkaline rocks in Brazil and South Africa.

Alkaline rocks are scattered throughout the major intrusive belts of the world. However, there are only about 28 known locations world-wide where rock characteristics have been determined as favorable for uranium deposits. Eleven principal locations are in the United States; the remaining 17 are scattered, primarily throughout Europe and Africa. Figure 2 shows the 28 locations of favorable alkaline and related igneous rocks world-wide.

Alkaline igneous rocks form a complex series of intrusives associated with granitic rocks. Alkaline intrusives are characterized as feldspathoid-rich rocks containing abundant rock-forming minerals of aluminum, sodium and potassium in a quartz-poor environment. The mineral-mix may occur in almost any ratio as $KNaAlSi_3O_8$. Actually, three different rock-types represent a favorable host for uranium. The most favorable alkaline rocks include the varieties rich in sodium and potassium with little aluminum oxide. They are referred to as peralkaline rocks. If the rock contains little or no quartz, it is classified as nepheline syenite. As the quartz content increases, a syenite grades into a less favorable granite. In any case, the rock is characterized by a higher-than-normal content of rare elements including zirconium, niobium, rare earths and uranium. The favorable localities for uranium in this rock-type are Ilimaussaq, Greenland and Pocos de Caldas, Brazil.

The second rock-type is peralkaline granites which form a group of oversaturated alkaline rocks high in iron content but deficient in aluminum oxide. The quartz content may be as high as 40 percent. The rock contains abundant dark, rock-forming silicate minerals of the pyroxene group. Rock containing anomalous quantities of uranium and other rare elements will usually contain less than 30 percent quartz. The uranium deposit at Bokan Mountain, Alaska occurs in peralkaline granite.

The third favorable alkaline rock is classified as a carbonatite, a carbonate-rich intrusive closely associated with alkaline rocks. Carbonatites may occur in a zonal arrangement with other alkaline rocks, or form ring dikes and breccia zones within caldera-like structures. The carbonatites are characterized by high phosphate content and abundant rare elements consisting predominantly of rare earths, uranium and thorium. Uranium is recovered as a by-product to copper mining of a carbonatite complex at Palabora in South Africa.

The concentration of uranium in igneous rocks varies greatly by rock type. The average uranium content will vary from about 0.003 to 5 parts per million (ppm). However, igneous rocks with 6 to 20 ppm uranium are common. Higher amounts are generally uncommon except where differentiation of rock-forming constituents shows concentration as in certain granites, pegmatites and alkaline rocks.

Uranium mineralization in the granite at Rossing, Namibia grades up to 1000 ppm uranium. The granites near Johan Beetz, Quebec contain local concentrations, or pods, that average about 70 ppm uranium. At Bokan Mountain, the peralkaline granite contains 20 to 200 ppm uranium with localized concentrations above 10,000 ppm, or 1 percent U_3O_8 occurring in veins and fractures.

The concentration of uranium in alkaline rocks is generally higher than in other igneous rocks, a situation due to the unusually high content of rock-forming elements. The nepheline syenite series of Greenland, Brazil and Russia contain anomalous uranium—from 62 ppm at the Ilimaussaq occurrence in Greenland, to 2,000 ppm at Pocos de Caldas in Brazil. The economic favorability of such occurrences may be dependent upon the concentration of important minerals in addition to uranium, such as molybdenum, iron, zirconium and rare earths. The occurrence of high-grade uranium at Bokan Mountain is peculiar to that deposit; otherwise, high-grade ore is limited to isolated pods containing only a small tonnage of minable material.

Uranium Occurrences

Of the 28 locations where favorable alkaline rocks are known, only about six have been evaluated for the economic potential of uranium. The occurrence of

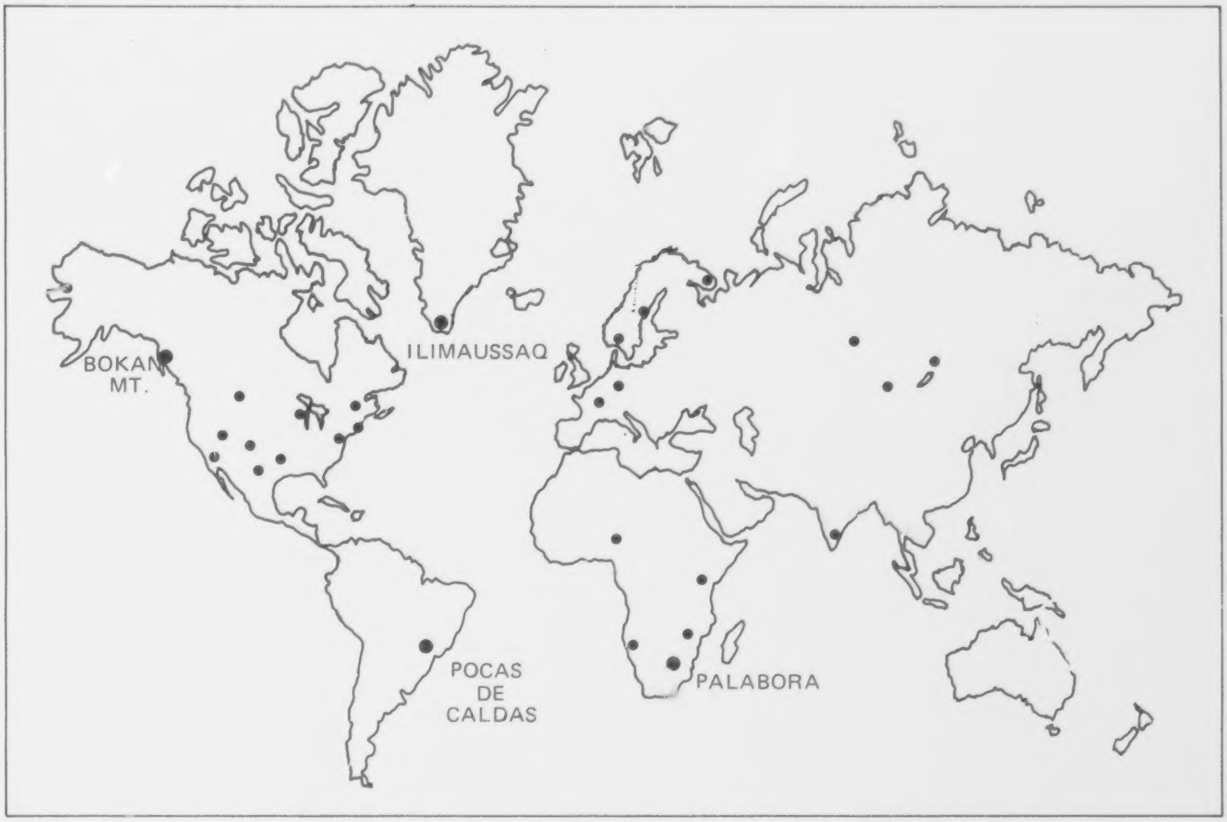

Figure 2
LOCATION OF POTENTIAL URANIUM-BEARING ALKALINE, PERALKALINE AND CARBONATITE INTRUSIONS, WORLD-WIDE THE NAMED OCCURENCES ARE DESCRIBED IN THE TEXT.

anomalous uranium has been noted in each case. Four of the locations are described according to the important characteristics for each rock-type and mineral association.

Ilimaussaq, Greenland The Ilimaussaq igneous complex of southwest Greenland is the host of a number of radioactive anomalies occurring in peralkaline nepheline syenites. The Geological Survey of Greenland has spent about 10 years evaluating the more promising areas of which the Kvanefjeld district is perhaps the most important of at least five major mineralized districts. The evaluation program is still in progress; however, the survey has announced the discovery of approximately 32,000 tonnes U_3O_8 contained in 30 million tonnes ore. The uranium mineralization is disseminated throughout the rock in concentrations from 0.01 to 0.30 percent U_3O_8; the average content is 0.03 percent U_3O_8.

The peralkaline intrusives are included in the upper portion of the Gardar Formation which consists of a number of interbedded intrusive flows, dikes and basaltic lavas. The complete sequence occupies a large fault graben in Precambrian granite. The age of the Gardar is considered to be Precambrian also, dating from 1,500 to 1,000 million years ago. The important alkaline rocks are among the youngest in the formation at 1,040 to 1,000 million years of age.

Important uranium mineralization is concentrated in the coarse-grained fraction of stratified nepheline syenites, usually associated with segregated black and

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green rock-forming minerals. Such rocks are classified as lujavrites. The black rocks, especially along thin recrystallized zones and in structurally favorable areas (fractures and breccia zones) show the greatest concentration of uranium. The intrusion of the lujavrites has paralleled the main structural trends within the basement granites and a dominant northwest-southeast-trending fracture pattern that developed in the volcanic flows above the lujavrites. Exploration is directed toward such structural features.

The uranium mineral present is steenstrupine, a phosphate and silicate of rare earths containing niobium, tantalum, thorium and uranium. The uranium content of the rock shows evidence of enrichment in zones of alteration. Steenstrupine is considered to be both a primary and secondary mineral under this circumstance. Monazite is a secondary mineral of little economic importance.

Pocos de Caldas, Brazil Uranium mineralization occurs in a host of peralkaline rocks on the Pocos de Caldas Plateau located in the extreme southwestern part of the State of Mines Gerais. The plateau is a structural dome covering about 700 square miles. It was created during Upper Cretaceous time by intrusions of nepheline syenites (referred to locally as foyaites) into gneisses and granites of Precambrian age and sediments of Mesozoic age.

Uranium occurs in two forms at Pocos de Caldas. The more common occurrence is in association with zirconium in the mineral caldasite which is a mixed mineral of zircon ($ZrSiO_4$) and baddeleyite (ZrO_2). Caldasite is the principal ore mineral mined as a source of zirconium. It has not been an important source of uranium in the past due primarily to unfavorable economics of producing by-product uranium.

Disseminations of uranium occur throughout the caldasite, probably as a substitute for zirconium in the zircon lattice. Rock alteration has been intense in certain localities and in one altered zone, the secondary uranium mineral meta-autunite has been identified. Hydrothermal mineralization consisting of zircon, iron, molybdenum and uranium, is commonly associated with brecciated zones in coarse-grained foyaites.

Important uraniferous zirconium ores occur in at least four different environments. *Placer deposits* are favored for mining because the caldasite has been concentrated to 60-80 percent ZrO_2; *eluvial deposits* formed as a thin surface mantle (average thickness of about two feet) covering hill slopes offers easy mining but limited tonnage; *vein deposits* are scattered throughout the plateau area, but have been mined on a limited basis only because of lower grade ore and unfavorable economics; *disseminated deposits* show local concentrations of caldasite in decomposed rock, but is considered uneconomic for zirconium mining. Only a small amount of by-product uranium has been recovered during the mining of placer deposits where the uranium concentration had been naturally upgraded to about 0.50 percent U_3O_8.

Important uranium-molybdenum deposits are known in the Agostinho and Cercado districts of the central plateau area. At Agostinho, amorphous uranium mineralization is disseminated along the contact zones of fine to coarse-grained foyaite. Minor amounts of coffinite and uranothorite have been identified as associated minerals with zirconium, pyrite, flourite and molybdenum.

The uranium content of the deposit varies from a trace to one percent or more U_3O_8; the average is 0.02 percent U_3O_8. The uranium mineralization is closely associated with the pyrite and fluorite in altered breccia. The source of all mineralization is assumed to be associated with hydrothermal activity. The uranium was probably introduced simultaneously with the pyrite. In areas of intense alteration, the ratio of most minerals has been upgraded, especially the zirconium uranium ratio.

Five important ore deposits have been discovered in the Cercado district. The deposits occur in breccia zones separated by narrow bands of barren rock. Three deposits will be mined form one large open pit. The ore is to be processed in a nearby mill designed to produce 450 to 550 tonnes U_3O_8 per year.

The mineral suite at Cercado is similar to Agostinho, but generally includes different associations due to intense weathering and alteration. Uranium mineralization occurs with caldasite, as pitchblende nodules common to alteration fronts associated with fluorite, zirconium and molybdenum, and in oxidized ores as coffinite and uranothorite.

The uranium reserves of the Agostinho and Cercado deposits have not been listed separately. However reserves of the Pocos de Caldas region have been estimated by Nuclebras at about 20,000 tonnes U_3O_8. The close proximity and similarity of ores at the Agostinho deposit suggests that all ore from Agostinho will be processed at the Cercado mill which should be in operation during 1981.

Bokan Mountain, Alaska The Bokan Mountain uranium deposit located on the southern tip of Prince of Wales Island at the south end of the Alaskan panhandle, was discovered by prospectors in 1955. Development began in 1957 and about 500,000 pounds U_3O_8 were mined from a multi-vein system by open pit methods. Several years later, approximately one million pounds of high-grade ore was mined by underground methods from a downward extension of the mineralized zone. Subsequent exploration drilling of the ore trend from surface and underground stations resulted in the addition to ore reserves of one million to 1.3 million pounds U_3O_8, most of which may be accessible from existing underground workings.

The Bokan Mountain deposit has been the most productive to date from alkaline rocks; the present reserve situation suggests that it is one of the more important known occurrences in an alkaline environment. It also indicates the importance of post-Precambrian-aged granites as a potential source of uranium.

Bokan Mountain is a peralkaline syenite and granite stock of Jurassic age (190 to 170 million years old) introduced into massive quartz monzonite and grandiorites of Ordovician age (450 to 430 million years old). Pre-Ordovician metasediments and metavolcanics were further metamorphosed during the intrusion of alkaline rocks. The entire intrusive complex occurs in a highly deformed synclinal belt that developed along the western margin of North America during Mesozoic time. The structural stresses that developed during the formation of the syncline and the subsequent intrusion of alkaline rocks created zones of faulting, brecciation and fracturing in the older rocks, many of which were later mineralized by hydrothermal solutions passing through the broken rock.

The main ore deposit developed in the alkaline rocks and consists of an "S" shaped core of high-grade ore that mined out at about one percent U_3O_8. The ore zone was 6 to 25 feet thick. The high-grade core was more or less surrounded by a halo of low-grade mineralization, limited primarily to parallel structures and related veins. In fact, existing ore reserves are confined mostly to a parallel shear zone and a minor structural pattern which trends 40 to 60 degrees of the main shear zone.

The dominant ore minerals are uranothorite and uranian thorianite. The uranium minerals are probably syngenitic to the intrusion of alkaline rock, and show further concentration as a result of alteration during the period of hydrothermal activity. Mineralization precipitated in the older rocks at that time. Coffinite occurs as a minor ore mineral. Rock alteration and the occurrence of anomalous concentrations of uranium minerals in association with hematite, fluorite, zircon and thorium in favorable structural traps (faults, breccia and fractures) confirms the movement of mineral-rich solutions throughout all rock types.

Two small satellite ore deposits are known to occur in the older granites surrounding the Bokan Mountain deposit. Uraninite is the main uranium mineral present. It occurs in close association with hematite and fluorite in highly brecciated and fractured zones. Again, development of the ore deposits is probably a result of mineralized solutions moving along zones of broken rock during and after the intrusion of peralkaline rocks.

Palabora, South Africa Uranium at Palabora is contained in a carbonatite segment of the Palabora intrusive complex. Anomalous radioactivity was investigated as early as 1951 at what is now the Palabora mine site. It was determined that the radioactivity was due to the dissemination of minor amounts of uranothorianite associated with low-grade copper sulfide deposit. Ore reserves available by open pit mining methods were estimated at several hundred million tonnes containing an average copper content of 0.7 percent and uranium at 0.004 percent. The uranium that could be recovered as a by-product to copper has been estimated by the South African Atomic Energy Board at 3,000 to 11,000 tonnes U_3O_8, depending upon the availability of copper ore to the current mining practice. Uranium production during 1979 and 1980 was a total of approximately 530,000 pounds U_3O_8.

The main orebody at Palabora is a vertical volcanic pipe, referred to as the Loolekop pipe, occupying the central core of the Palabora Igneous Complex. The complex consists of "staged" intrusives into a country rock of Precambrian granite gneiss. The last two stages of intrusions consisted of alkaline syenites and carbonatite, both of which occupy the Loolekop pipe. The central core of carbonatite is the main host for the concentration of copper sulfides and associated minerals. Important concentrations of magnetite occur in the carbonatite and in the syenites along the outer edges of the pipe.

All mineralization in the pipe has accumulated in veinlets of the highly fractured portions of the carbonatite as a result of mineralizing solutions flooding the fractured zones. The veinlets are completely cemented by copper sulfides.

Important accessory minerals, in addition to uranothorianite, include magnetite, babbeleyite, galena, gold, silver and several nickel-bearing sulfide ores. All by-product minerals occur in small percentages and are recoverable only because of the large scale operations at Palabora.

Summary

The concentration of uranium in alkaline rocks is notably low, with the exception of the Bokan Mountain deposit. The favorable criteria for such deposits suggests that the occurrence of low-grade uranium will be the rule, high-grade uranium will be the exception. It can be concluded that a uranium-bearing alkaline occurrence would be exploitable only if it is very large and contains an accessory mineral of greater economic importance than uranium. The Pocos de Caldos and Palabora occurrences are examples of this. The world supply demand situation for U_3O_8 will influence exploration groups in their search for alkaline uranium occurrences. Under present circumstances, it is probable that any new uranium discoveries in alkaline rocks will be incidental to the search for more economically important minerals.

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STATISTICAL DATA

EXCHANGE VALUE—$27.00/lb U_3O_8
Determined as of December 31, 1980

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of December 31, 1980

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
27.70	2.7	10	4

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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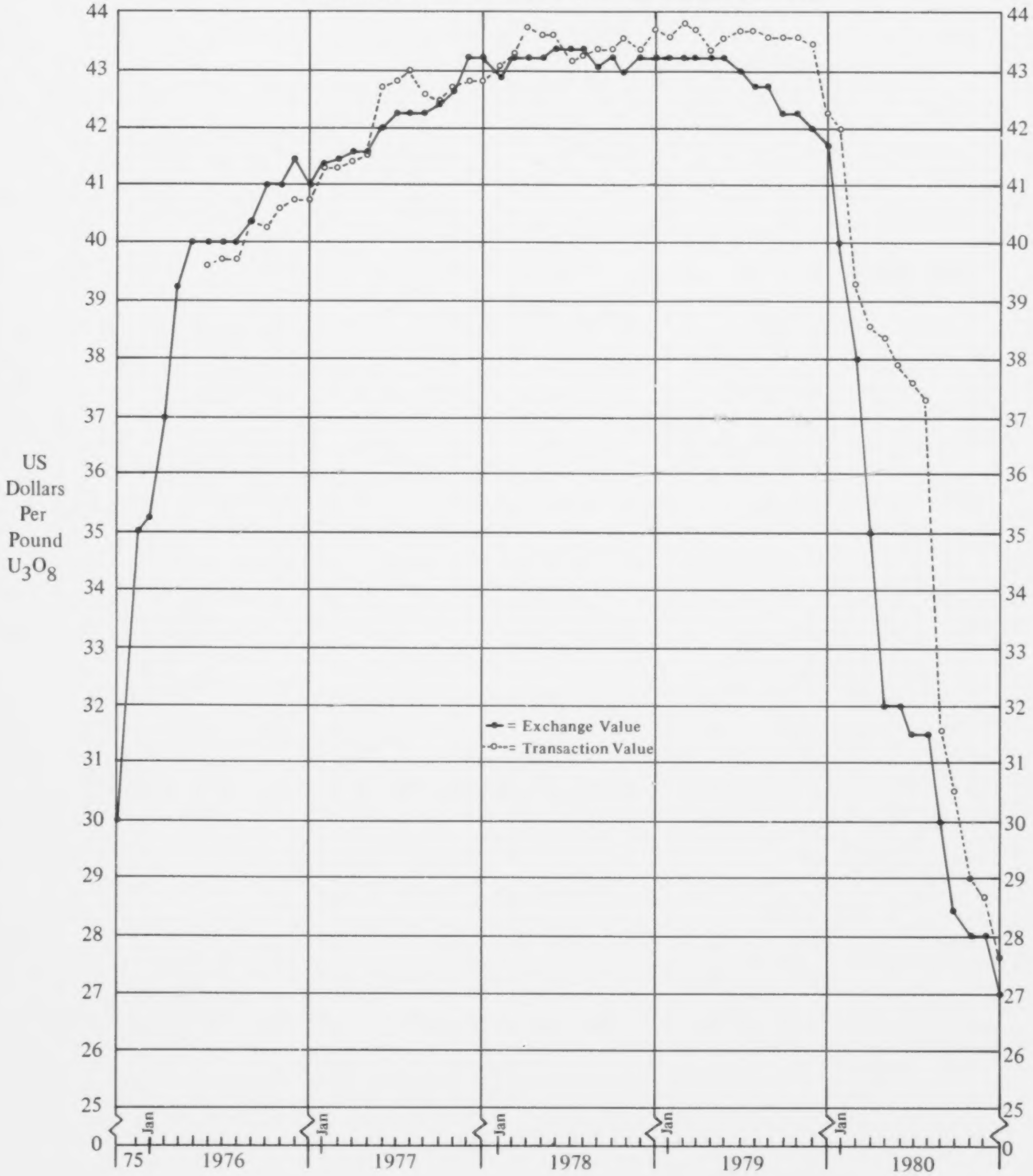
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE NOVEMBER 1975

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated

(US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00

Note: See earlier Nuexco Reports for evolution of the definition of Exchange Value.

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated

(US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70

Note: See Nuexco Report 135 for a discussion of the definition of Transaction Value.

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STATISTICAL DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	27.00	59.52	70.19
France (franc)	122.06	269.10	317.33
FRG (mark)	52.95	116.74	137.66
Japan (yen)	5,476	12,072	14,235
Switzerland (franc)	47.79	105.35	124.24
UK (pound)	11.31	24.94	29.41
Australia (dollar)	22.85	50.38	59.42
Canada (dollar)	32.14	70.85	83.55
Niger, Gabon (CFA)	6,103	13,455	15,867
South Africa (rand)	20.11	44.34	52.29

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

LOAN USE CHARGE RATE—7.0%/year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.
B. Rates included in firm proposals to borrow or lend.
C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
1302	80-81	301 – 600	101	US	US	
1325	80	Less than 50	–	US	US	Not an arms-length transaction

---

*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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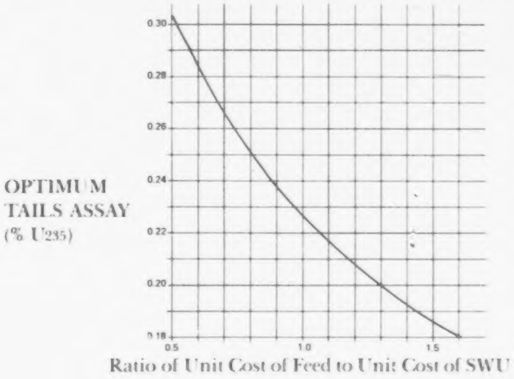
STATISTICAL DATA

OPTIMUM TAILS ASSAY

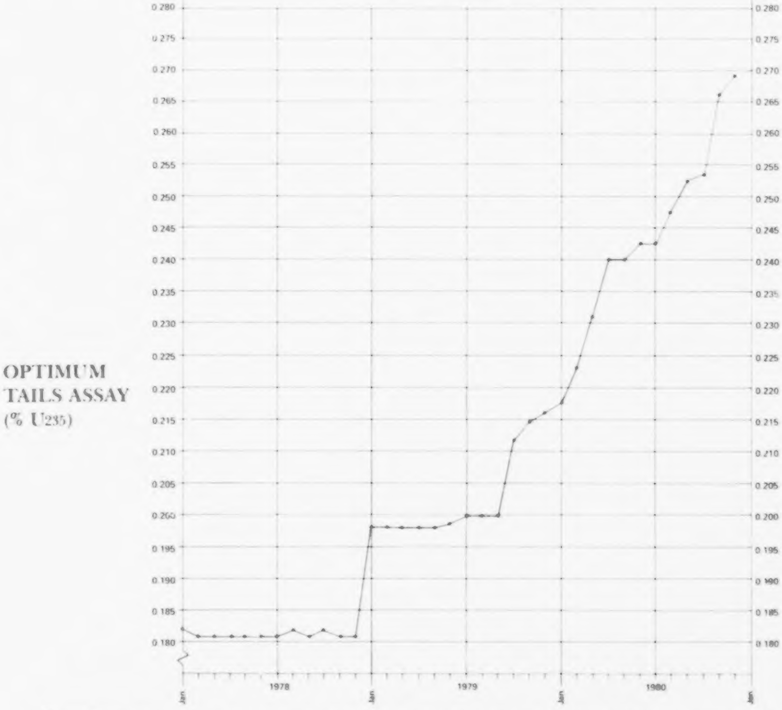
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1]Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]		
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970 (5)	110.0	116.3	91.36	3.88	3.87	3.69
Annual Avg. 1971 (5)	114.1	121.3	96.02	4.12	4.15	3.97
Annual Avg. 1972 (5)	117.9	125.3	100.00	4.56	4.59	4.26
Annual Avg. 1973 (5)	125.9	133.1	105.80	4.84	4.98	4.51
Annual Avg. 1974 (5)	153.8	147.7	116.02	5.44	5.63	4.88
Annual Avg. 1975 (5)	171.5	161.2	127.15	6.13	6.24	5.39
Annual Avg. 1976 (5)	182.4	170.5	133.71	6.76	6.87	5.91
Annual Avg. 1977 (6)	195.1	181.5	141.70	7.28	7.67	6.43
Annual Avg. 1978 (6)	209.4	195.4	152.05	8.23	8.56	7.02
Annual Avg. 1979 (6)	236.5	217.4	165.46	9.27	9.49	7.60
Sep 1979	244.2	223.4	167.20	9.63	9.79	7.74
Oct 1979	249.0	225.4	–	9.67	9.87	7.83
Nov 1979	250.6	227.5	–	9.78	9.85	7.88
Dec 1979	253.1	229.9	170.58	9.80	9.92	7.92
Jan 1980	260.6	233.2	–	9.91	10.06	7.97
Feb 1980	265.9	236.4	–	9.92	10.01	8.01
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05
Apr 1980	271.3	242.5	–	10.00	10.30	8.12
May 1980	271.2R	244.9	–	10.18	10.37	8.17
Jun 1980	273.0R	247.6	178.93	10.13	10.69	8.24
Jul 1980	276.2R	247.8	–	10.24	10.82	8.35
Aug 1980	277.3	249.4	–	10.38	10.78	8.39
Sep 1980	278.2	251.7	182.92	10.54	10.94	8.46
Oct 1980	281.2P	253.9	–	10.64P	10.95P	8.52P
Nov 1980	282.7P	256.2	–	–	–	8.60P

P = Preliminary   R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Data for 1970-1976, monthly except for the GNP Implicit Price Deflator, and Price Index data for 1977-1978 appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Employment and Earnings data for 1977-1979, monthly, appear on page 33 of Nuexco Report 147.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970(3)	101.4	59.88
Annual Avg. 1971(3)	101.5	65.95
Annual Avg. 1972(3)	105.6	71.26
Annual Avg. 1973(3)	124.4	78.96
Annual Avg. 1974(3)	141.9	108.07
Annual Avg. 1975(3)	150.4	132.55
Annual Avg. 1976(3)	168.4	160.93
Annual Avg. 1977(3)	192.0	179.03
Annual Avg. 1978(3)	215.4	190.04
Annual Avg. 1979	248.5	196.34
Jul 1979	298.2	199.22
Aug 1979	293.2	201.43R
Sep 1979	302.4	202.24R
Oct 1979	309.4	201.70R
Nov 1979	310.4	201.05R
Dec 1979	319.4	201.85R
Jan 1980	340.1	215.71R
Feb 1980	345.6	215.18
Mar 1980	340.3	214.81
Apr 1980	327.9	215.12
May 1980	335.1	214.78R
Jun 1980	338.4	214.11R
Jul 1980	349.1	221.41R
Aug 1980	353.2	219.70
Sep 1980	351.6P	219.15P
Oct 1980	348.7P	219.37P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Aug 1979	220.0	9.56	7.38	7.77
Sep 1979	223.4	9.75	7.50	7.81
Oct 1979	227.4	9.89	7.54	7.88
Nov 1979	228.1	9.97	7.61	7.91
Dec 1979	230.4	9.93	7.51	7.89
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1R	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.2	10.49	8.11	8.55
Aug 1980	249.1R	10.58P	8.14P	8.65P
Sep 1980	251.6	10.71P	8.26P	8.70P
Oct 1980	254.9P	—	—	—

P = Preliminary R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)
Annual Avg. 1970 (3)	7.34	100.3 (4)
Annual Avg. 1971 (3)	7.88	106.4 (4)
Annual Avg. 1972 (3)	8.79	113.3 (4)
Annual Avg. 1973 (3)	10.51	124.1 (4)
Annual Avg. 1974 (3)	13.18	138.5 (4)
Annual Avg. 1975 (3)	16.71	157.2 (4)
Annual Avg. 1976 (3)	19.30	174.7 (4)
Annual Avg. 1977 (3)	23.87	194.4 (4)
Annual Avg. 1978 (3)	27.14	137.2
Annual Avg. 1979 (3)	30.18	155.3
Sep 1979	30.71	162.1
Oct 1979	–	162.9
Nov 1979	–	163.4
Dec 1979	31.89	164.0
Jan 1980	–	165.4
Feb 1980	–	167.0
Mar 1980	33.65	168.0
Apr 1980	–	170.0
May 1980	–	171.9
Jun 1980	34.48R	174.6
Jul 1980	–	177.2
Aug 1980	–	179.2
Sep 1980	36.19	182.8
Oct 1980	–	186.3
Nov 1980	–	187.8

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(1) Chamber of Mines of South Africa, Johannesburg; "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria; "Government Gazette: Consumer Price Index for Urban Areas."
(3) Historical data for 1970 through 1979 appear on page 4.9 of Nuexco Report 140.
(4) April 1970 = 100.00

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1392	200			
1393	60	175	175	Long term
1475	1000			UF_6
1480	500			
1481	250			
1490	1000			
1533	400			
1534	400			
1540	750			UF_6
1547	100			
1550	1000			UF_6
1551	150			
1552	600			
1559	300			
1562		150	150	Long term
1570	600			
1571	30			
1576	200			
1577		300		
TOTALS	7540	625	325	
Available for Loan:				
1429	500			
1492	900			UF_6
1520	1000			UF_6
1531	500			UF_6
TOTAL	2900			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
Inquiries to Purchase:				
1459		200	200	Long term
1462			100	Long term
1513	200			
1529			550	Long term
TOTALS	200	200	850	
Inquiries to Borrow:				
1553	900			
TOTAL	900			

*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1451	150			
1475	850			
1540	650			
TOTAL	1650			

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1488	100			
1532	750			
TOTAL	850			

***Measured from the date of this Report.**

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 149

The **Exchange Value** declined to $27.00 per pound U_3O_8 from $28.00 the previous month. The total of inquiries to sell in the spot and near term markets was about 7.5 million pounds U_3O_8 equivalent, while the total of inquiries to purchase in the same time frame was relatively small. This imbalance alone put some downward pressure on the market, as some sellers reduced their offering prices somewhat. However most potential buyers have indicated a willingness to purchase only at much lower prices. Thus there is currently a substantial difference, about two to three dollars per pound, between bid and asked price levels.

The **Transaction Value** declined to $27.70 per pound U_3O_8 from $28.70 the previous month. Two transactions closed, both involving sales from US producers to US producers; the prices were lower than the previous month's Exchange Value.

The **Japanese** government recently adopted an official target for non-oil energy supplies designed to reduce reliance on imported oil from the present 73 percent to 50 percent by 1990. As a part of this plan, it is intended that nuclear generating capacity will be increased from the current 15,000 MWe to between 51,000 and 53,000 MWe by 1990.

The future of **US** energy policy under the new administration was given direction in a report by President-elect Reagan's energy advisors headed by Michael Harbouty. The Harbouty Report, which calls for the revitalization of the US nuclear power program, is outlined in the *Commentary* section of this Nuexco Report.

A significant portion of the world's uranium production is *captive* to the end user of the uranium. The magnitude and influence of captive production on world uranium market is discussed in the *Topical Essay* of this Report.

The *Raw Materials* essay in this Report is a summary of major world uranium occurrences in alkaline rocks.

This Executive Summary may be reproduced for internal distribution.

1/81

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FEBRUARY 1981 NUMBER 150

Monthly Report on the Uranium Market

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NUEXCO

MONTHLY REPORT ON THE URANIUM MARKET

February 1981 No. 150

JAMES E. VAUGHAN, *EDITOR*

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FOREWORD

We are happy to announce that Judy Sellers has joined the Nuexco staff as a Market Analyst. Judy came to Nuexco from Phillips Uranium Company. She is a graduate of the University of California at Berkeley where she majored in economics.

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URANIUM MARKET

GENERAL

Uranium Production in 1980

Nuexco's preliminary estimates of uranium production for the major uranium producing nations in 1980 are summarized in Table 1. Production for 1979 is also shown for comparison.

Table 1

ESTIMATED URANIUM PRODUCTION
(millions of pounds U_3O_8)

	1979	1980
United States	37.6	42.5
Australia	1.8	3.9
Canada	17.8	18.7
Republic of South Africa	12.5	15.7
Other Africa	22.2	23.4
France	5.2	5.6
TOTAL	97.1	110.8

Production in 1980 increased by 14 percent over 1979 to a total of 110.8 million pounds U_3O_8. The biggest changes were in the US and the Republic of South Africa.

Nuexco had previously estimated that US production would decline in 1980 by as much as ten percent from the 37.6 million pounds U_3O_8 produced in 1979. In fact it appears that US production *increased* by ten percent in 1980. Due to the weakening price situation, Nuexco had suggested that many US production centers would cut back in 1980. Actually many cutbacks and layoffs were announced during the year, but these generally did not impact on 1980 concentrate production levels. The main reasons for this were the existence of substantial ore stockpiles which were fed into mills notwithstanding cutbacks in mining efforts. Also, there turned out to be a longer-than-expected lag time between the fall in the market and the implementation of reduced production. Finally the nature of the open pit mining operation makes for a substantial additional lag time in phasing down output. If workers involved in stripping overburden are laid off, the effect on ore output is usually not felt until six to nine months later. The progressive nature of the open pit mine usually requires that overburden be removed well in advance of mining the ore.

An additional 8.3 million pounds U_3O_8 were produced in the US in 1980 above Nuexco's mid year estimate of 34.2 million pounds. All of this additional material was produced from conventional mines and mills. The distribution by state is as follows, in millions of pounds U_3O_8:

New Mexico	4.2
Wyoming	2.2
Texas	1.3
Others	0.6
TOTAL	8.3

Approximately 80 percent of the unexpected production came from operations controlled by multinational companies. About 70 percent of the additional 8.3 million pounds was produced in open pit operations. Of the total, 5.2 million pounds U_3O_8 were added to inventories, over and above previous Nuexco inventory figures. (3.3 million pounds of which were added to user inventories in the form of additional contract deliveries; 1.9 million pounds were added to producer inventories in the form of unsold or undelivered production.) The balance of 3.1 million pounds was previously expected by Nuexco to be purchased by producers for redelivery under contracts, however the material was in fact produced.

In the Republic of South Africa, production increased in 1980 by a total of about 25 percent, to 15.7 million pounds U_3O_8. The increase was mainly due to:

1. The Chemwes plant reaching full rated output (188 percent production increase over 1979).
2. The new Vaal Reefs South Plant building up to rated capacity (38 percent increase over 1979).
3. Additional capacity coming on line at JMS (45 percent increase over 1979).
4. Randfontein building up to rated capacity and solving startup metallurgical problems (56 percent increase over 1979).
5. Ergo having improved metallurgical efficiencies (23 percent increase over 1979).

The increase in Australia production was mainly due to the 1980 startup of Queensland Mines Nabarlek mill. The increase in Canada was largely the result of the full year's operation of Rio Algom's Panel mill. The increase in Africa was due to the expanded capacity of the Arlit facility in Niger.

Nuclear Generation in 1980

Total nuclear electric generation for North

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America, Western Europe and the Far East are tabulated in Table 2 for 1980. The years 1978 and 1979 are also shown for comparison. Nuclear generation decreased in the US from the previous year. France, Japan and Sweden all had substantial gains from 1979. Total nuclear electric production for the three regions increased to 610 million megawatt hours, an eight percent overall gain from 1979.

Table 2

NUCLEAR ELECTRIC POWER GENERATION
(millions of megawatt-hours, gross)

	1978	1979	1980
North America			
Canada	33	38	40
United States	293	271	265
Total North America	326	309	305
Western Europe			
Belgium	13	12	12
Finland	3	7	7
France	31	40	61
FRG	33	40	44
Italy	4	3	2
Netherlands	4	4	4
Spain	8	7	5
Sweden	21	21	27
Switzerland	8	12	14
UK	37	39	37
Total Western Europe	165	185	213
Far East			
Japan	51	62	81
Rep. of China (Taiwan)	3	6	8
Rep. of Korea	2	3	3
Total Far East	56	71	92
TOTAL	547	565	610

Sweden and Switzerland continue to lead in total relative dependence on nuclear power. About 27 percent of Sweden's production in 1980 was nuclear, and during the last annual accounting period about 27 percent of Switzerland's production was nuclear. Approximate nuclear shares for other European nations include Belgium 23 percent; France 22 percent; and UK and FRG at 12 percent each. In the Far East, the nuclear power dependence of Japan was about 13 percent, Taiwan 19 percent and Korea seven percent. In North America, nuclear dependence of the US was about 12 percent. In the Province of Ontario, Canada, nuclear production was about 30 percent of total production.

The US percentage of total generation has decreased from 54 percent in 1978 to 48 percent in 1979 and 43 percent in 1980.

Transactions in 1980

The year 1980 saw a significant erosion of prices, and the size, quantity, and flow of transactions followed a dramatic swing to a buyer's market. Table 3 details the transactions reported in the Nuexco Monthly Report during 1980 by geographical region.

US sellers dominated spot and near term activity. Some 69 percent of the material transferred in spot and near term transactions involved US sellers. However, longer term transactions were dominated by non-US sellers.

Australian producers had an active year, as their longer term transactions represented almost 30 percent of the total. The dominance of Australian activity in 1980 is highlighted by the fact that the figures in Table 3 do not include transactions between Energy Resources of Australia (ERA) and its Japanese and German shareholders. These ERA transactions are described in detail in the *Australia* section of this Report.

Canada and Africa continued to emphasize longer term marketing, and each captured a sizeable portion of this market. The generally aggressive Canadians also participated actively in the spot market.

On the buy side, European buyers were very active in 1980 in both the spot and longer term market as the nuclear programs of several nations cleared hurdles and purchases were made in anticipation of nuclear expansion. European buyers tended to spread their purchases among African, US, Australian, and Canadian producers.

This same diversification of supply was shown by buyers in the Far East. These buyers have generally ignored the spot market, and 1980 was no exception. Despite an apparently comfortable inventory position, contracts were signed for a significant quantity of long term material by Far East buyers.

Table 4 is an update of a table first presented in Nuexco Report 147 showing the breakdown of sales between producers and nonproducers for 1980. It incorporates the last two months of 1980 as well as

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Table 3

SUMMARY OF TRANSACTIONS REPORTED IN THE NUEXCO MONTHLY REPORT DURING 1980[1]

(number of transactions and thousands of pounds U_3O_8 involved)

SPOT AND NEAR TERM TRANSACTIONS[2]

	Buyer Group				
Seller Group	**Europe**	**Far East**	**US**	**Other**	**Total**
Africa	—	—	—	2 (1,000)	2 (1,000)
Australia	—	—	—	—	—
Canada	1 (300)	—	1 (800)	1 (100)	3 (1,200)
USA	9 (2,200)	1 (*)	32 (6,100)[3]	1 (*)	43 (8,300)
Other	5 (1,000)[4]	1 (*)	1 (200)	1 (400)	8 (1,600)
TOTALS	15 (3,500)[4]	2 (*)	34 (7,100)[3]	5 (1,500)	56 (12,100)

LONGER TERM TRANSACTIONS[2]

	Buyer Group				
Seller Group	**Europe**	**Far East**	**USA**	**Other**	**Total**
Africa	2 (8,700)	1 (8,000)	—	—	3 (16,700)
Australia[6]	2 (4,800)[6]	1 (3,000)[6]	1 (4,500)	—	4 (12,300)[6]
Canada	—	1 (4,200)	—	—	1 (4,200)
USA	4 (1,600)	1 (3,100)	2 (3,400)	—	7 (8,100)
Other	—	—	—	1 (600)[5]	1 (600)
TOTALS	8 (15,100)	4 (18,300)	3 (7,400)	1 (600)	16 (41,900)

[1] Nuexco Reports 138 through 149.

[2] Near Term means delivery within one year after contract signature. Longer Term means final delivery more than one year after contract signature.

[3] Includes four loans totalling 900,000 lbs U_3O_8 equivalent and two U_3O_8/UF_6 swaps totalling 400,000 lbs U_3O_8 equivalent.

[4] Includes 1 loan totalling 100,000 lbs U_3O_8.

[5] Includes 1 loan totalling 600,000 lbs U_3O_8.

[6] Totals for Australia do not include 1980 Transactions between Energy Resources of Australia and its Japanese and German shareholders. These ERA Transactions are described in detail in the *Australia* Section of this Report.

*Quantities less than 50,000 pounds U_3O_8.

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Table 4

SPOT AND NEAR TERM[1] SALES TRANSACTIONS REPORTED IN THE NUEXCO MONTHLY REPORT DURING 1980[2]

(number of transactions and thousands of pounds U_3O_8 involved)

	Buyer				
Seller	**US Producer**	**US Non-Producer**	**Non-US Producer**	**Non-US Non-Producer**	**Total**
US Producer[3]	9 (1,475)	8 (1,591)	—	8 (1,371)	25 (4,437)
US Non-Producer[4]	6 (1,055)	4 (1,176)	—	3 (385)	13 (2,616)
Non-US Producer	—	1 (750	2 (370)	5 (2,092)	8 (3,212)
Non-US Non-Producer	—	1 (210)	1 (210	1 (28)	3 (448)
TOTALS	15 (2,530)	14 (3,727)	3 (580)	17 (3,876)	49 (10,713)

[1] Near term means delivery within one year after contract signature.

[2] Nuexco Reports 138 through 149.

[3] "Producer" means companies directly involved in mining uranium.

[4] "Non-producer" includes utilities, government agencies, fuel fabricators and others not directly involved in mining uranium.

new information about previously tabulated transactions. In comparing Table 4 with the earlier version in Report 147, it seems that the trend of utility sales and producer purchases has increased, especially in the US.

The figures in Table 3 suggest that the major change in marketing during 1980 was the shift in emphasis away from the US, both as a producer and as a consumer. The relative stagnation of the US nuclear power industry indicated that non-US producers would increasingly look to the more active non-US markets. Meanwhile, the status of most US producers as the marginal cost producers of the world generally led to buyers' looking elsewhere for longer term contracts. There was very little long term activity by US buyers, especially with non-US sellers.

AUSTRALIA

A contract was announced this month between Oskarshamnsverkets Kraftgrupp Aktiebolag (OKG) of Sweden and Uranium Resources of Australia (ERA). The contract is for a total of 6.3 million pounds U_3O_8 with deliveries extending from 1982 through 1996. OKG also acquired a one percent equity interest in ERA. The current share holdings in ERA are set forth in Table 5. Table 6 summarizes the existing sales commitments of ERA. The nominal capacity of the Ranger mill is 6.6 million pounds U_3O_8 per year, so the facility is now essentially fully committed through 1990.

Table 5

SHAREHOLDERS OF ENERGY RESOURCES OF AUSTRALIA (ERA)

Shareholder	Percent
Peko-Wallsend	30.49
EZ Industries	30.49
Australia public	14.02
JAURD	10.00
UG Australia Development (Urangesellschaft)	4.00
Inter-uranium Australia (Saarberg-Interplan)	3.75
Rheinische Braunkohlenwerke (RWE)	6.25
OKG	1.00

EUROPE

Several new nuclear units in the Comecon group of countries have recently become operational, or are nearly ready:

1. The first unit of the nuclear unit at Rovno in the West Ukraine was placed into operation in December 1980. This unit is a 440 MWe PWR. A second identical unit is under construction at this site.

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Table 6
ENERGY RESOURCES OF AUSTRALIA (ERA) SALES COMMITMENTS, BY YEAR
(thousands of pounds U_3O_8)

	1981/1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
American Electric Power Co.	500	500	500	500	500	500	500	500	500	—	—	—	—	—	—
Korea Electric Co.	—	500	500	500	500	500	500	500	500	500	500	—	—	—	—
Federal Republic of Germany[1]	2,100	2,240	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
JAURD[2]	1,200	1,200	1,500	1,500	1,500	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Other Japanese Contracts[3]	1,760	600	600	600	800	—	—	—	—	—	—	—	—	—	—
Repayment of loan to Australian Government	1,000	1,000	228	—	—	—	—	—	—	—	—	—	—	—	—
OKG	200	900	400	400	400	400	400	400	400	400	400	400	400	400	400
Other Europe	50	50	50	300	300	300	300	300	300	300	300	300	300	—	—
Totals	6,810	6,990	6,578	6,600	6,800	6,500	6,500	6,500	6,500	6,000	6,000	5,500	5,500	5,200	5,200

[1] The three participants in ERA from the Federal Republic of Germany are UG Australia Development, Inter-uranium Australia, and Rheinische Braunkohlenwerke.

[2] Japan-Australia Uranium Resource Development Company (JAURD) is jointly held by Kansai Electric (50 percent), Kyushu Electric (25 percent), Shikoku Electric (15 percent) and C. Itoh and Company (10 percent).

[3] These contracts with Kyushu Electric and Chubu Electric were first signed in the early 1970's.

2. The fourth 1,000 MWe unit of the nuclear station Leningrad achieved criticality in December, 1980. In the first half of 1981 two more 1,000 MWe units (Kursk 3 and Tschernobyl 3) are scheduled for operation in the USSR.

3. The third 440 MWe nuclear unit at Kozloduj in Bulgaria also commenced operation in December 1980. The fourth unit will be in operation by the end of 1981. At that time, Bulgaria will have the highest percentage of electrical production from nuclear power in the Comecon group of countries.

By 1985 the USSR expects to more than triple its annual production of nuclear electicity, from 70 million megawatt-hours in 1980 to an estimated 220 million megawatt-hours in 1985. Installed capacity in 1985 is expected to be about 25,000 MWe.

FAR EAST

From the inception of their nuclear power programs, Japan's utilities have been unique in their concern about security of uranium supply. Even among those nuclear nations lacking uranium resources, Japan has stood out in terms of tonnage under contract, number and diversity of sources, inventory size, and years of forward coverage. Now despite this situation, there are indications that a number of Japanese utilities are having discussions with potential sellers about arrangements for uranium supply beginning in the late 1980's and extending into the late 1990's and beyond. It may be presumed that the current period of market weakness and oversupply is seen by the Japanese as presenting an usual opportunity to tie up additional tonnage. In keeping with the past practice, the potential suppliers represent African, Australian and Canadian sources.

Meanwhile in Korea, the economic slowdown has prompted a re-examination of load growth forecasts and that country's extremely ambitious nuclear program. As a consequence, a number of discussions concerning long term uranium supply have been put on hold as the Koreans review their nuclear program and associated uranium needs.

While they are similar to the Japanese in being totally dependent on imported uranium, the Koreans, unlike the Japanese, have shown themselves to be extremely price sensitive. In this they resemble US utilities, particularly in their resistance to price arrangements that could cause them to pay more than perceived market levels. It is now likely that further contracting by Korea will await better definition of future uranium needs.

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URANIUM MARKET

UNITED STATES

Westinghouse Electric Corp. and Gulf Oil Corp. announced a settlement to their antitrust litigation. Under the settlement Gulf will pay Westinghouse $25 million, and Gulf will provide or deliver some 13 million pounds U_3O_8 to six Westinghouse utility customers. A summary of Westinghouse settlements with its uranium customers was presented in Nuexco Report 141.

It was announced that uranium mineralization has been discovered in northwest Nebraska. Wyoming Fuel Company owns a 50 percent interest in the prospect, now called Crow Butte, and Ferret Exploration Company owns the remaining 50 percent. Geologists at Crow Butte estimate potential reserves at more than 25 million pounds U_3O_8, making it one of the largest discoveries in the US in recent years. Test drillings indicate a uranium oxide content of about 0.1 percent. Much of the mineralization is shallow enough to be surface mined and the rest could probably be mined using solution mining techniques.

TRANSACTIONS

Four material sales are reported this month. The largest involves the sale announced by Energy Resources of Australia (ERA) to Oskarshamnsverkets Kraftgrupp Aktiebolag (OKG) of 6.3 million pounds U_3O_8 for delivery from 1982 through 1996 (see ***Australia*** section).

Also a long term sale of between one and three million pounds U_3O_8 was completed from a Canadian producer to a European utility. A spot sale of less than 50 thousand pounds U_3O_8 was made from a US producer to another US producer. Finally a US nuclear contractor sold a quantity between 300 thousand and 600 thousand pounds U_3O_8 to a US producer.

One sale of conversion services on the secondary market is reported this month. A US nuclear contractor sold conversion services to a US utility.

PRICING

The Exchange Value decreased to $25.00 per pound U_3O_8 from $27.00 last month. As discussed in Nuexco Report 149, a gap had opened between sellers' offers and buyers' bids, with the latter at the $25 level. In January, several sellers reduced prices in order to close transactions. One transaction was in fact closed at the level of this month's Exchange Value and others are under discussion. Since large amounts of material are involved in these discussions, it is clear that the leading edge of prices has dropped considerably since the previous month.

Material available for spot and near term sale, as listed in the *Market Opportunities* section of this Report, totals 8.2 million pounds U_3O_8 equivalent. This far outweighs the total of 710,000 pounds U_3O_8 in inquiries to purchase on the spot and near term market. However a $25 Exchange Value has often been mentioned as a reference level at which several US producers have indicated they would come into the market to make additional purchases. Now that the Exchange Value has come down to that level, additional demand may be forthcoming.

CONVERSION

Beginning with this issue, Nuexco will publish a market value for the sale of conversion services. The Conversion Value is Nuexco's judgment as to the price at which transactions for conversion services in the spot and near term market could be concluded as of the end of the month.

While previous Nuexco Reports (e.g. Reports 138 and 143) have identified and followed this growing market, the increase in both opportunities and completed spot conversion transactions over the past 18 months points to the importance of a monthly commercial value for conversion services.

Measured as a percentage of near term Material Available for Sale in the *Market Opportunities* section of the Nuexco Report, UF_6 has increased from six percent of the total in May 1979 to 36 percent in December 1980, reaching a high of 53 percent in September 1980. As a percentage of total near term Material Available for Loan opportunities, UF_6 has maintained an average of about 50 percent over the past two years.

Despite the many offerings to sell and lend, however, UF_6 has not in fact moved well in the market. U_3O_8 is the preferred commodity in today's market and this corresponds to the rising demand for "deconversion" services—exchanging UF_6 for the more marketable concentrates.

The emergence of this market is an indirect result of the enormous uranium stockpiles which users have

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accumulated because of delayed reactor start-up dates. The stockpiles are most often in the form of UF_6. With concentrates the more salable today (most utilities already have conversion contracts), a holder of UF_6 wishing to sell from a stockpile often must "deconvert" its material to find a buyer.

The delay in reactor start-ups has also meant that some utilities possess long term conversion contracts that they do not currently need. Certain of these utilities are willing to offer their contracted conversion services for sale at a price below that of the primary market.

However the most common transaction in the secondary market for conversion services is the swap, wherein UF_6 is exchanged for an equivalent quantity of concentrates, plus cash or additional concentrates as payment for the conversion services. This framework is useful for the inventory holder wishing to deconvert holdings from UF_6 to concentrates.

Transactions of this type have been structured as follows:

1. The seller of the conversion services (seller) instructs its conversion contractor (converter) to make UF_6 deliveries as required by the buyer of the conversion services (buyer).
2. The buyer delivers an equivalent amount of concentrates to the seller's account at a location specified by the seller.
3. After completion of the swap, the seller invoices the buyer for the agreed conversion price, or an additional quantity of concentrates is delivered in lieu of a cash payment.

The conversion price is the payment for receiving the upgraded material.

In the case of a utility wishing to sell excess conversion services, the transaction would involve a partial or complete assignment of the conversion contract. Thus structured, utility A would "subcontract" its conversion services to utility B. i.e. utility B would convert its U_3O_8 by means of utility A's contract. A contract between utility A and utility B would be constructed so that utility A would act as the "converter", receiving U_3O_8 from utility B and delivering UF_6 by way of its own conversion contract.

Although opportunities for conversion services in the secondary market have been limited to the short term, the possibility of long term opportunities is beginning to be considered. While more complicated in design, the longer term "sub-contracting" structure may be an alternative for a utility whose conversion services obligation stretches for many years without a corresponding need.

The price of near term conversion services in the secondary market will be determined to a large extent by the pressure to sell stockpiled UF_6. For a utility lacking a conversion contract, this opening of a secondary market may provide a less expensive means of converting its material. The growing significance of this market points to the importance of setting a regular commercial value on these conversion services.

Therefore beginning this month Nuexco will publish a monthly Conversion Value for spot and near term conversion sales. This month's Conversion Value is $1.20 per pound U as UF_6. The definition and derivation of the Conversion Value are found in the *Statistical Data* Section of this Report.

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COMMENTARY

GOVERNMENT AND THE US URANIUM INDUSTRY

In recent months, much discussion has revolved around actions which the US government might take to aid the domestic uranium industry. The problem is that more than 40 million pounds U_3O_8 were produced in the US 1980, and less than 17 million pounds actually consumed. Furthermore, only a few new plants are being licensed per year, and annual consumption from new starts is building at a rate of less than two million pounds U_3O_8 per year. US consumption will not reach 1980 production rates for more than ten years. Short term solutions to the industry's problems are therefore needed. Even accelerated completion of plants under construction, desirable as that may be, will not solve the US industry's problems within the next few years.

Inventories are important. US utilities hold approximately 120 million pounds U_3O_8 equivalent in inventory. US government stockpiles are approximately 135 million pounds U_3O_8 equivalent. The combined industry and government inventories are adequate to supply all US plants operating today for more than ten years without another pound being mined or imported.

When the US situation is viewed separately, it is clear that the future of the US supplier industry is bleak if it is limited to serving only the US where production already exceeds actual demand, and inventories are ample and growing. The driving force supporting the US industry today is existing contracts, and many of these contracts are approaching termination within a few years. In the absence of an unconventional solution, supply and demand will eventually be forced back into balance by declining price.

The obvious need is for the US industry to export. Success in exporting requires taking advantage of whatever strengths the US can muster while compensating for the disadvantage of low grade ore. What measures can the US government take in other areas to compensate for high cost production?

At present the US Export-Import Bank finances uranium as part of a sale of a nuclear steam supply system. Uranium opportunities not associated with equipment sales are, of course, available and would benefit from Export-Import Bank support. Separate reloads which may not presently qualify for Export-Import Bank financing could be included for favorable treatment by a change in government policy. The effect should be to help encourage US purchases even when nuclear systems are purchased from non-US suppliers.

A second, admittedly complex, suggestion would require a major government initiative. The US government owns a strategic stockpile of about 135 million pounds U_3O_8 equivalent. It is, *in reality*, holding that stockpile for the benefit of other free world nations as well as the US. The US government would not likely fail to act if friends were forced by uranium shortages to discontinue nuclear electric power operations.

Security of nations lacking domestic production and enrichment capability could be enhanced by national stockpiles within national boundaries. Japan, for example, could benefit by an enriched UF_6 inventory held *within* Japan. As Japan has the capability to fabricate finished fuel from enriched UF_6, an enriched UF_6 stockpile would allow self-sufficiency on the entire front-end for a time. A case can be made, consequently, that non-US uranium users should assist in financing the free world's stockpile. In addition, the security of user nations could be enhanced at the same time.

This could be accomplished if the US government would endeavor to sell a major portion of its government enriched uranium stockpile to user nations, particularly Japan and the Federal Republic of Germany. Part of the understanding associated with the sale would be that the material would be held in those countries as a strategic stockpile. This is actually a variation of the "uranium bank" idea.

Material thus sold from the US stockpile could be replaced by US government purchases from domestic suppliers. The domestic purchase could be financed by revenue received from the overseas sales of enriched UF_6. Domestic demand of the order of five to ten million pounds per year for five years or more might result. This would help absorb some excess domestic production.

An obstacle to US uranium sales outside the US is the declining confidence in the soundness and consistency of US government nuclear policy. End use controls and uncertainty with regard to reliability of supply has removed the US in many cases as a favored source. Other supply sources are often favored to avoid US influence. Purchases from others, moreover,

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COMMENTARY

are sometimes made to *protest* US policy. These conditions are in clear need of change.

A final idea concerns favorable tax treatment of US uranium exports. Uranium exports do not presently qualify for preferred tax treatment under Deferred Income Sales Corporations (DISC). As DISC's were established to promote US exports, the inclusion of uranium would be in the interests of both US government and industry. Such a change in the rules deserves serious consideration.

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RAW MATERIALS

SOUTH TEXAS DISTRICT—PART I

Introduction

US uranium exploration and development activity during 1980 was estimated to be about 33 percent below the 1979 level. A decrease in activity was noted in every uranium district, except in South Texas where about 85 drill rigs operated continuously throughout the year—more than double the number operating in other districts. This high level activity resulted in new ore discoveries, the delineation of additional ore reserves, and the development of new production centers.

The growth of the district has progressed rapidly with the development of solution mining technology. Early prominence of the district was founded on open pit mining of shallow (to a depth of 150 feet) ore deposits in Karnes and Live Oak Counties beginning in the mid-1950's. Open pit mining in the two counties continues to contribute significantly to district activities. Simultaneous with the development of shallow ore deposits was the discovery of deeper ores which could not be recovered by conventional open pit or underground mining methods. The introduction of solution mining was a timely innovation for expanded development of the district.

In situ solution recovery tests were initiated in 1968 by Cities Service Corporation in southern Gonzales County and by Union Carbide Corporation at the Palangana salt dome in Duval County. The first tests met with partial success. Minor modification and adjustments in technology indicated that in situ solution mining of uranium was economically feasible. Further technological advances led to the first commercial scale in situ mining operation in Texas in 1975.

Uranium deposits amenable to in situ solution mining are characteristically low in uranium content, consist of poorly consolidated sandy sediments, natural ground water flow is consistent, and ore depth is beyond the economic limitations of open pit mining. The deeper South Texas deposits have all the favorable characteristics for in situ mining.

In Situ Solution Mining

In situ solution mining of uranium is accomplished by the circulation of chemical solutions (lixiviant) through an ore zone to dissolve the uranium minerals. The enriched solution is recovered for further processing. Ideally, the ore zone should be overlain and underlain by a non-porous formation to help prevent loss of lixiviant to other formations. Solution movement is controlled by forced flow through properly spaced injection and recovery wells. Water pressure differential confines the lixiviant within the limits of the well pattern which usually includes four injection wells evenly spaced around one recover well. A production unit consists of multiple well patterns connected in the same controlled environment.

The lixiviant is prepared from on-site ground water with special chemicals added to cause dissolution of the uranium. The chemicals commonly used depend upon formational characteristics, ground water makeup, and certain environmental considerations. They consist of an anionic agent such as bicarbonate/carbonate, plus the addition of a strong oxidant to create soluble uranium, which, in turn, gradually enriches the lixiviant. The most widely used carbonates are ammonium carbonate and sodium carbonate; hydrogen peroxide and pure oxygen are the only oxidants used. A high volume of pure oxygen dissolved into the lixiviant stream is rapidly gaining acceptance as an efficient recovery technique. The effective use of chemical reagents diminishes as the depth of leaching action increases. The carbonates can gradually be replaced by an increasing amount of dissolved oxygen. Overall chemistry of the leaching process improves as depth and formation pressure increase.

The uranium-rich solution is pumped to the surface and the uranium is collected on resin beads upon passing through an ion exchange system. The barren lixiviant is again prepared chemically for reinjection into the leach field. The loaded resin is then passed through an elution column where the uranium is stripped out and transferred as slurry to the precipitation circuit. The uranium-rich slurry is passed through a thickener and finally a centrifuge to increase the uranium content to about 60 percent U_3O_8. After precipitation, the material is either dried and packaged at the site or it is shipped as a slurry concentrate to the Kerr-McGee conversion plant in Sequoyah County, Oklahoma.

There are potential advantages to in situ solution mining over conventional mining and milling methods. In situ leaching allows for the recovery of lower grade mineralization, minimizes environmental impact, can proceed at lower capital costs and reduced

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manpower requirements. A potential disadvantage is related to ground water clean-up at the end of the leach cycle. Industry experience with the clean-up process is limited to only a few case histories. Thus far, the cleanup process has proved to be difficult and new technology is under development. The use of smaller amounts of chemical reagent and more oxygen in the lixiviant is considered advantageous to the final clean-up process. Figure 1 is an aerial view of an in situ leach recovery plant in Duval County, Texas.

Development History

Uranium mineralization in the South Texas district occurs in Eocene-Miocene strata of Tertiary age. The original discovery was made along the flanks of Todilla Hill in Karnes County during 1954. By mid-1958, about 200 uranium occurrences had been reported in the new district. Subsequent prospecting has led to discoveries throughout the trend of the Tertiary sequence from Fayette County south to the Rio Grande.

The first sustained mining operation was initiated by Susquehanna Western, Inc. (SWI) at Deweesville, Karnes County in 1960, followed by the construction of a 200 ton per day acid leach mill in 1961. The initial ore to be processed had been mined by Climax Molybdenum Company and stockpiled by the US Atomic Energy Commission in 1958. The last of the stockpiled ore was blended and processed with the first ores mined by SWI from shallow open pit mines in Karnes County. By 1964, SWI was mining along the ore trend in Live Oak County.

Until 1963, all known ore deposits around the Todilla Hill area contained oxidized ore. SWI discovered an unoxidized deposit at a depth of 130 feet about that time. The discovery was a significant milestone for the district. It broadened exploration potential to greater depths throughout the trend and almost all subsequent discoveries have occurred in the deeper environment. The unoxidized deposits proved to be much larger than the oxidized deposits and SWI expanded its total mining rate to 400 tons per day in 1965. Mill capacity was increased a like amount at the same time. SWI operated at the expanded rate until early 1973 when all mining and milling was terminated.

The tempo of activity began to increase throughout the district in 1967-68. The Atomic Energy Commission reported 6.4 million feet of drilling in 1969 compared to 3.3 million feet in 1968. Ore reserves were estimated at 3.8 million tons averaging 0.18 percent U_3O_8, or about 13,680,000 pounds U_3O_8. SWI production in 1968 was 1.2 million pounds U_3O_8.

SWI was the only company mining uranium in the district until 1969. Tenneco began mining at that time on the extension of a deposit being mined by SWI. Tenneco was one of the first of about 25 companies to undertake exploration in the district during the 1965-69 period. SWI built a 400 ton per day carbonate mill at Ray Point in 1970 to process the Felder ore mined by Exxon. That mill was shut down in 1973 for economic reasons.

The Conoco/Pioneer Nuclear joint venture, known as the Conquista project, began exploring throughout the Karnes County area in 1968. The program was successful and the venture began operating its newly constructed 1,750 ton per day mine and acid leach mill at Dewessville in 1972. The mill was expanded to 3,500 tons per day in 1979. According to a recent announcement by the venture partners, the project mining and milling rate will be cut back to approximately 1,700 tones ore per day beginning January 1981. An additional 400 tons ore per day mined by Exxon from the Felder deposit is to be toll milled at the Conquista plant. Chevron (Standard Oil of California) was the last to develop a conventional open pit and acid leach mill in the district. Chevron began operating a 3,000 ton per day mine and mill at its Pannamaria property near Hobson in eastern Karnes County in 1979.

District Geology

Uranium deposits of the South Texas district occur in Tertiary sediments which outcrop in a trend closely paralleling the shoreline of the Gulf of Mexico. The trend of mineralization extends to the southwest about 400 miles from Fayette County to Starr County on the US/Mexico border. (The mineral trend is known to continue another 100 miles into Mexico.) Figure 2 shows the stratigraphic relationship of the ore-bearing formations. Figure 3 shows the outcrop pattern of the Tertiary formations throughout the mineral trend. The principal areas of interest are within Karnes, Live Oak and Duval counties. Important uranium mineralization has been found in eight stratigraphic units of late Eocene to Pliocene age.

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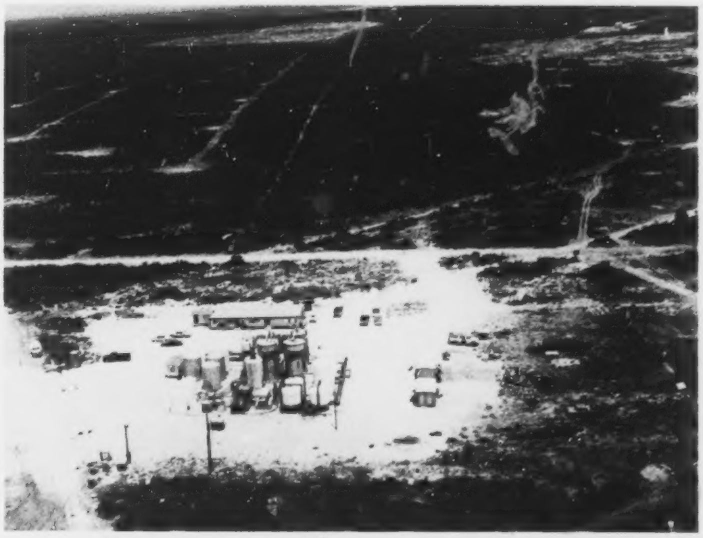

Figure 1

AERIAL VIEW OF URANIUM RESOURCES INC. 1200-GALLON-PER-MINUTE IN SITU SOLUTION PLANT AT BENAVIDES, DUVAL COUNTY, TEXAS.

Geologic Age	Geologic Unit		Description
Holocene	Flood-plain alluvium		Sand, gravel, silt, clay
	Terrace deposits		Sand, gravel, silt, clay
Pleistocene	Deweyville/Beaumont		Sand, gravel, silt, clay
Pliocene	Goliad Sandstone	■	Ore—fine to coarse sand & conglomerate, clay
Miocene	Fleming Formation		Calcareous clay & sand
	Oakville sandstone	■	Ore—Calcareous, coarse sand, lower portion favored
Oligocene	Chusa tuff		Calcareous tuff, clay gravel near base
	Soledad conglomerate	■	Ore Soledad—in Duval Co. grades to sand northward
	Fant tuff	□	Ore—Lower portion
	Frio Clay	□	Ore—Gray to green clay, lower portion—sandy
Eocene	Fashing clay		Clay, lignite, sand
	Tordilla sandstone	■	Ore—fine sand
	Dubose		Sand, clay, lignite, silt
	Deweesville sandstone	■	Ore—fine sand, silt, clay
	Conquista clay		Carbonaceous clay
	Dillworth sandstone	□	Ore—fine sand

Figure 2

STRATIGRAPHIC SECTION OF THE URANIUM-BEARING TERTIARY SEQUENCE, SOUTH TEXAS URANIUM PROVINCE. URANIUM-BEARING UNITS ARE NOTED: ■ = MAJOR URANIUM SOURCE; □ = MINOR URANIUM SOURCE

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RAW MATERIALS

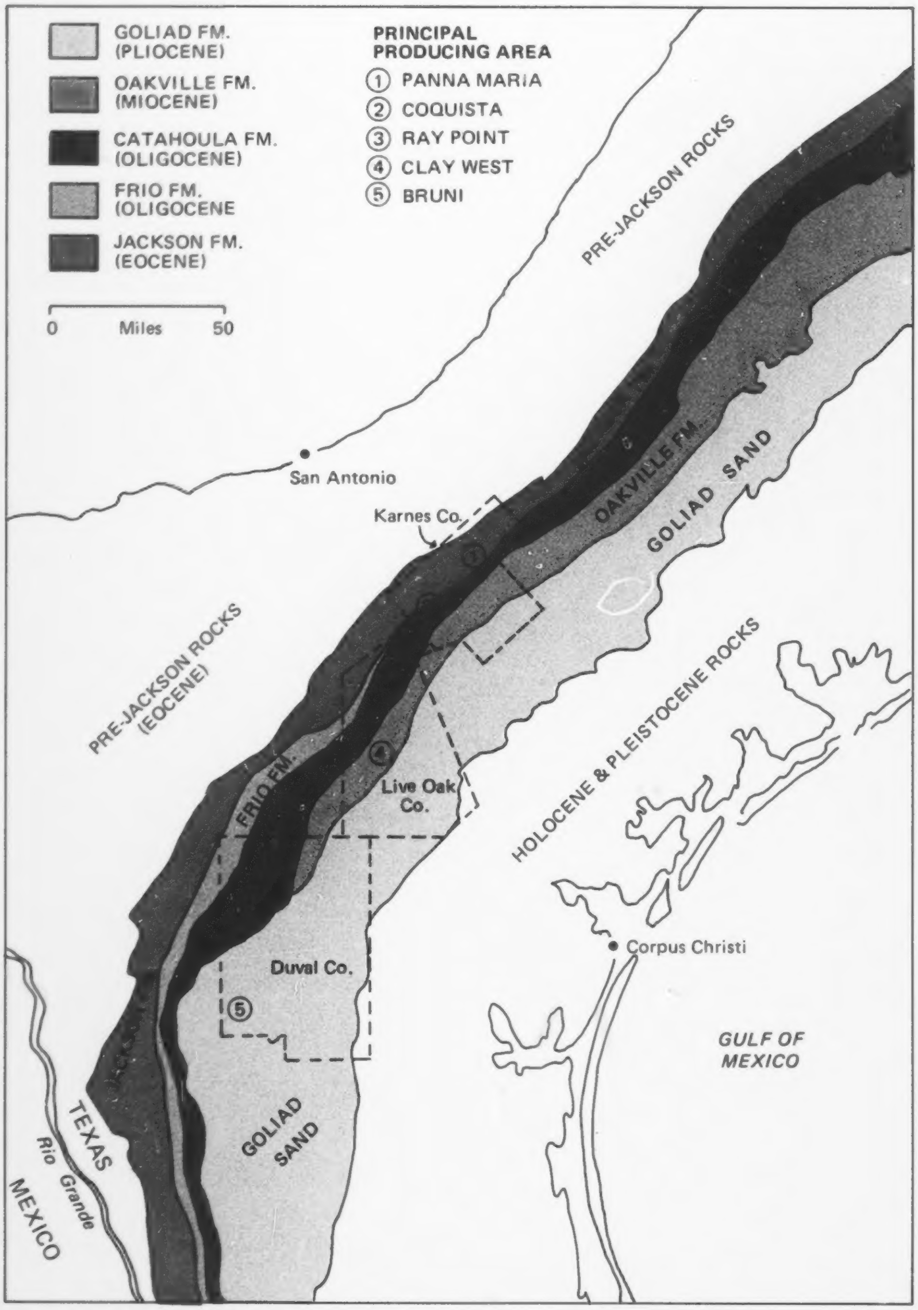
GOLIAD FM. (PLIOCENE)
OAKVILLE FM. (MIOCENE)
CATAHOULA FM. (OLIGOCENE)
FRIO FM. (OLIGOCENE
JACKSON FM. (EOCENE)
0 Miles 50
PRINCIPAL PRODUCING AREA
① PANNA MARIA
② COQUISTA
③ RAY POINT
④ CLAY WEST
⑤ BRUNI
PRE-JACKSON ROCKS
San Antonio
Karnes Co.
OAKVILLE FM.
GOLIAD SAND
PRE-JACKSON ROCKS (EOCENE)
HOLOCENE & PLEISTOCENE ROCKS
FRIO FM.
Live Oak Co.
Duval Co.
Corpus Christi
GULF OF MEXICO
GOLIAD SAND
TEXAS
Rio Grande
MEXICO
JACKSON

Figure 3

GEOLOGIC MAP OF THE SOUTH TEXAS URANIUM DISTRICT SHOWING TREND OF URANIUM-TERTIARY FORMATIONS AND PRINCIPAL URANIUM PRODUCING AREAS.

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Evidence of structural activity throughout the district is limited to a one degree dip of the beds toward the Gulf Coast and faulting which tends to parallel the strike of the Tertiary formations. Faulting is more prominent in the northeast portion of the trend. Uranium host formations show zero to 40 feet of displacement along faults. The faulting has acted to control the placement of ore in certain areas. Such structural controls are prominent along the Oakville trend in Live Oak County where several ore deposits occur within graben structures. Occasionally ore is found adjacent to a fault plane which served to restrict the flow of uranium-rich solutions and thereby contributed to the placement of an ore deposit. Such uranium occurrences adjacent to faulting were subjected to the continual migration and leaching action by ground water, resulting in some cases, to the redistribution and reprecipitation of the uranium. Age dating of ores from certain oxidized deposits suggests that the age of the ore varies from 15,000 to 25,000 years to more than 250,000 years. In fact, the process of leaching, migration and redeposition of uranium is considered a continuing process even in today's weathering environment.

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STATISTICAL DATA

EXCHANGE VALUE—$25.00/lb U_3O_8
Determined as of January 31, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.

B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of January 31, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
27.20	3.1	10	4

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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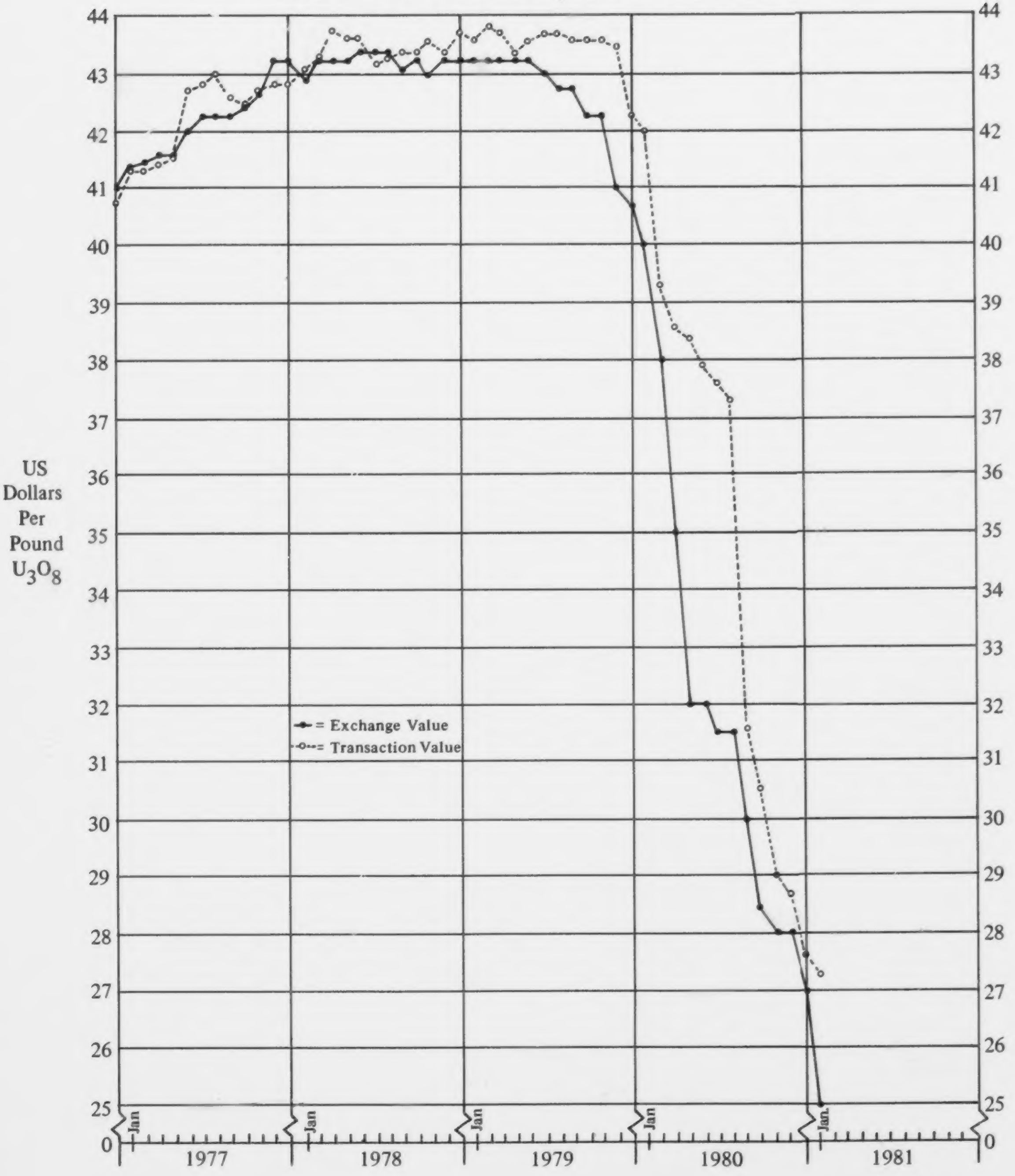
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00											

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20											

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	25.00	55.12	64.99
France (franc)	120.71	266.13	313.83
FRG (mark)	52.42	115.57	136.29
Japan (yen)	5,111	11,269	13,289
Switzerland (franc)	47.60	104.94	123.75
UK (pound)	10.42	22.97	27.09
Australia (dollar)	21.31	46.99	55.41
Canada (dollar)	29.89	65.90	77.72
Niger, Gabon (CFA)	6,036	13,306	15,692
South Africa (rand)	18.87	41.60	49.05

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

LOAN USE CHARGE RATE—7.0%/year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

CONVERSION VALUE—$1.20/lb. U as UF_6

Determined as of January 31, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which transactions for significant quantities of conversion services could be concluded on the spot and/or near term market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1353	83-95	1001 – 3000	–	Canada	Europe	Price is market related
1376	81	301 – 600	100	US	US	
1383	81	Less than 50	105	US	US	
1386	82-96	4001 – 7000	–	Australia	Europe	Definitive price information not available
Conversion Transactions						
1385	81	601 – 1000	92	US	US	Price is percent of Conversion Value

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*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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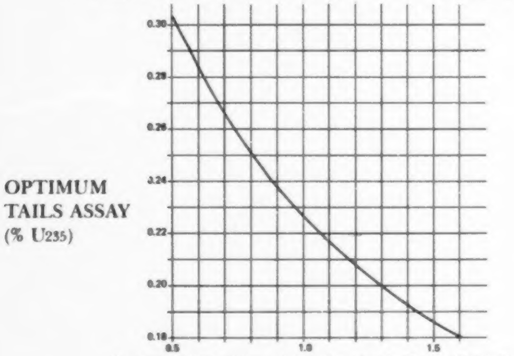
STATISTICAL DATA

OPTIMUM TAILS ASSAY

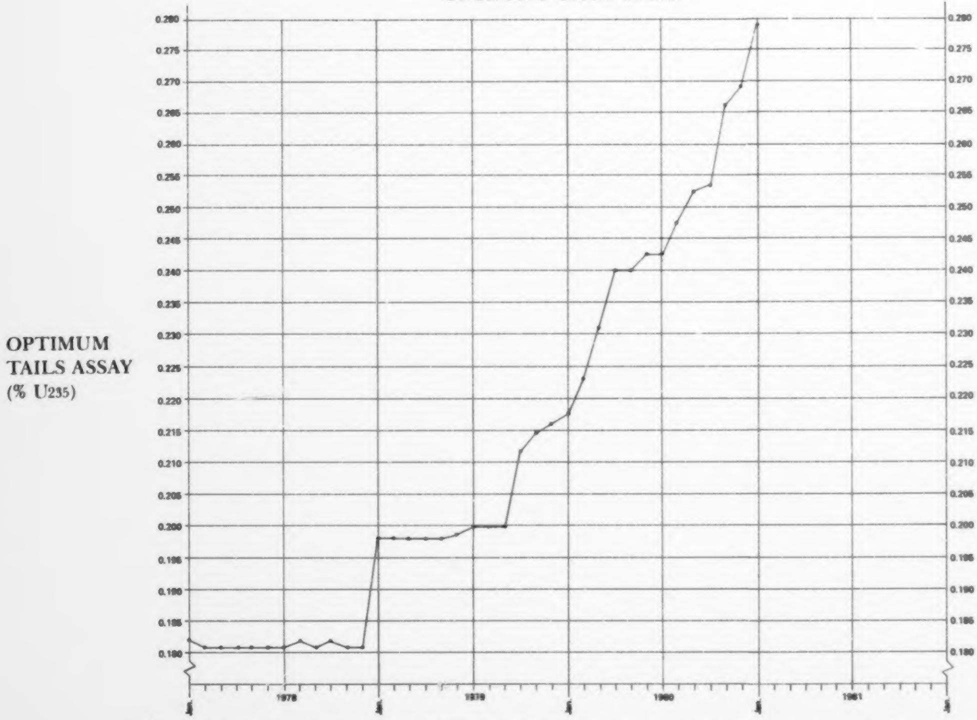
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]		
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970 (5)	110.0	116.3	91.36	3.88	3.87	3.69
Annual Avg. 1971 (5)	114.1	121.3	96.02	4.12	4.15	3.97
Annual Avg. 1972 (5)	117.9	125.3	100.00	4.56	4.59	4.26
Annual Avg. 1973 (5)	125.9	133.1	105.80	4.84	4.98	4.51
Annual Avg. 1974 (5)	153.8	147.7	116.02	5.44	5.63	4.88
Annual Avg. 1975 (5)	171.5	161.2	127.15	6.13	6.24	5.39
Annual Avg. 1976 (5)	182.4	170.5	133.71	6.76	6.87	5.91
Annual Avg. 1977 (6)	195.1	181.5	141.70	7.28	7.67	6.43
Annual Avg. 1978 (6)	209.4	195.4	152.05	8.23	8.56	7.02
Annual Avg. 1979 (6)	236.5	217.4	165.46	9.27	9.49	7.60
Oct 1979	249.0	225.4	–	9.67	9.87	7.83
Nov 1979	250.6	227.5	–	9.78	9.85	7.88
Dec 1979	253.1	229.9	170.58	9.80	9.92	7.92
Jan 1980	260.6	233.2	–	9.91	10.06	7.97
Feb 1980	265.9	236.4	–	9.92	10.01	8.01
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05
Apr 1980	271.3	242.5	–	10.00	10.30	8.12
May 1980	271.9R	244.9	–	10.18	10.37	8.17
Jun 1980	273.5R	247.6	178.93	10.13	10.69	8.24
Jul 1980	276.2	247.8	–	10.24	10.82	8.35
Aug 1980	278.2R	249.4	–	10.38	10.78	8.39
Sep 1980	278.2P	251.7	182.92	10.54	10.94	8.46
Oct 1980	281.2P	253.9	–	10.58	11.00	8.52
Nov 1980	282.7P	256.2	–	10.65P	11.09P	8.57P
Dec 1980	286.1P	258.4	183.98	–	–	8.64P

P = Preliminary   R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Data for 1970-1976, monthly except for the GNP Implicit Price Deflator, and Price Index data for 1977-1978 appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Employment and Earnings data for 1977-1979, monthly, appear on page 33 of Nuexco Report 147.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	215.4	190.04
Annual Avg. 1979	248.5	196.34
Aug 1979	293.2	201.43
Sep 1979	302.4	202.24
Oct 1979	309.4	201.71R
Nov 1979	310.4	201.05
Dec 1979	319.4	201.85
Jan 1980	340.1	215.72R
Feb 1980	345.6	215.18
Mar 1980	340.3	214.81
Apr 1980	327.9	215.12
May 1980	335.1	214.79R
Jun 1980	338.4	214.12R
Jul 1980	349.1	221.41
Aug 1980	353.2	219.70
Sep 1980	351.6	219.16
Oct 1980	348.7P	219.37P
Nov 1980	—	219.75P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Sep 1979	223.4	9.75	7.50	7.81
Oct 1979	227.4	9.89	7.54	7.88
Nov 1979	228.1	9.97	7.61	7.91
Dec 1979	230.4	9.93	7.51	7.89
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3R	10.49	8.11	8.55
Aug 1980	249.2R	10.58	8.14	8.65
Sep 1980	251.7R	10.76P	8.24P	8.71P
Oct 1980	255.1	11.02P	8.29P	8.81P
Nov 1980	256.9P	–	–	–

P = Preliminary   R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)
Annual Avg. 1970 (3)	7.34	100.3 (4)
Annual Avg. 1971 (3)	7.88	106.4 (4)
Annual Avg. 1972 (3)	8.79	113.3 (4)
Annual Avg. 1973 (3)	10.51	124.1 (4)
Annual Avg. 1974 (3)	13.18	138.5 (4)
Annual Avg. 1975 (3)	16.71	157.2 (4)
Annual Avg. 1976 (3)	19.30	174.7 (4)
Annual Avg. 1977 (3)	23.87	194.4 (4)
Annual Avg. 1978 (3)	27.14	137.2
Annual Avg. 1979 (3)	30.18	155.3
Oct 1979	–	162.9
Nov 1979	–	163.4
Dec 1979	31.89	164.0
Jan 1980	–	165.4
Feb 1980	–	167.0
Mar 1980	33.65	168.0
Apr 1980	–	170.0
May 1980	–	171.9
Jun 1980	34.48	174.6
Jul 1980	–	177.2
Aug 1980	–	179.2
Sep 1980	36.19	182.8
Oct 1980	–	186.3
Nov 1980	–	187.8
Dec 1980	–	189.9

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(1) Chamber of Mines of South Africa, Johannesburg; "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria; "Government Gazette: Consumer Price Index for Urban Areas."
(3) Historical data for 1970 through 1979 appear on page 4.9 of Nuexco Report 140.
(4) April 1970 = 100.00

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1392	400			
1393	60	175	175	Long term
1475	1000			UF_6
1480	500			
1490	1000			
1533	400			
1534	350			
1540	750			UF_6
1550	1500			
1551	200			
1552	600			
1562		150	150	Long term
1576	200			
1581	100	150	150	Long term
1589	140	300	300	Long term
1595	1000			
1600			200	Long term
TOTALS	8200	775	975	
Available for Loan:				
1429	500			
1492	900			UF_6
1602	400			
TOTAL	1800			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1459		200	200	Long term
1462			100	Long term
1513	200			
1514	400			
1529			550	Long term
1582	10			UF_6
1587		275	275	Long term
1603	100	100		Long term
TOTALS	710	575	1125	

Inquiries to Borrow:

*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1451	75			
1475	850			
1540	650			
1584	600	200	200	
1599	800	300		
TOTALS	2975	500	200	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1492	850			
1594	400		950	Long term
1596		650		
TOTALS	1250	650	950	

*Measured from the date of this Report.

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 150

The **Exchange Value** declined to \$25.00 per pound U_3O_8 from \$27.00 the previous month. At the beginning of January, there was a substantial difference, about two or three dollars per pound, between buyers' bids and sellers' offers. During the month, many sellers reduced prices in order to close transactions. One near term transaction did close at about this month's Exchange Value, and several others are under discussion at the same price levels.

The total of inquiries to sell in the spot and near term market was about eight million pounds U_3O_8 equivalent, while inquiries to purchase in the same time frame were less than one million pounds. However several potential US buyers had previously indicated an interest in entering the market if prices declined to the \$25 level. Thus additional near term demand may be forthcoming.

The Transaction Value declined to \$27.20 per pound U_3O_8 from \$27.70 the previous month. Two near term transactions closed this month involving US buyers and sellers. Also, a long term transaction was announced between Energy Resources of Australia and OKG of Sweden. Another long term contract was signed by a European buyer and a Canadian seller.

Beginning with this Report, Nuexco will publish a market price for spot and near term sales of conversion services. This new feature is in connection with the recent increase in conversion services available for sale in the secondary market, as well as recent transactions. The Conversion Value this month is \$1.20 per pound U as UF_6.

Nuexco estimates that production by the major free world uranium producing countries increased to about 111 million pounds U_3O_8 in 1980, a 14 percent increase over 1979. The major increases were in the US and South Africa. US production rose to 42.5 million pounds, from 37.6 million the year before. It had previously been expected that US production would drop in 1980. Production of nuclear electricity in the free world increased by about eight percent in 1980 although US output decreased slightly from the 1979 level.

This Report contains a review of 1980 uranium market activity. The *Commentary* section of this Report discusses action which the US government might consider to assist the domestic uranium industry. This month's *Raw Materials* essay covers the South Texas uranium district.

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MARCH 1981 NUMBER 151

Monthly Report on the Uranium Market

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MONTHLY REPORT ON THE URANIUM MARKET

March 1981 No. 151

JAMES E. VAUGHAN, *EDITOR*

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FOREWORD

There was a typographical error in Table 1 of last month's Report, Number 150. Production for France in 1980 should have been 6.6 million pounds U_3O_8, not 5.6 as indicated. The world total for 1980 of 110.8 million pounds U_3O_8 was correct.

The definition of the Conversion Value has been reworded somewhat this month for better clarity.

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URANIUM MARKET

GENERAL

Uranium Disputes

During its brief history and continuing to date, the commercial uranium industry has been beset by legal entanglements apparently unparalleled for an industry its size. A two-year grand jury investigation, a congressional investigation and a veritable blizzard of litigation have taxed the human and financial resources of buyers and sellers alike.

Because of several new suits and the changing identity of litigants in existing suits, Nuexco has summarized the status of ongoing uranium litigation below. This review is limited to publicly available information and describes the identity of the liti-gants, the issues in contention and the current status.

Richmond Case (Westinghouse)

This case was initiated in late 1975 and involved a multi-district preceding in the US District Court in Richmond, Virginia, a state court proceeding in Pennsylvania and a Swedish case. Plaintiffs are 17 US and three Swedish utilities. The defendant is Westinghouse.

Contention: Utilities sued Westinghouse for specific performance on uranium supply contracts and/or damages after Westinghouse announced its performance of these contracts was excused because performance would be commercially impracticable.

Status: Westinghouse has reached settlements with all utilities except Long Island Lighting where settlement negotiations are ongoing.

Chicago Case (Westinghouse)

This case was initiated in late 1976 and involves Westinghouse as plaintiff in a proceeding in the US District Court in Chicago, Illinois. The initial defendants were 29 US and non-US organizations as follows:

US
Rio Algom Corp.
Englehard Minerals and Chemicals Corp.
Denison Mines (US) Inc.
Gulf Oil Corp.
Kerr McGee Corp.
Anaconda Co.
Getty Oil Co.
Utah International Inc.
Phelps Dodge Corp.
Western Nuclear Corp.
Atlas Corp.
United Nuclear Corp.
Federal Resources Corp.
Pioneer Nuclear Corp.
Homestake Mining Co.
Rio Tinto-Zinc Corp.
Reserve Oil and Minerals Corp.

Canada
Rio Algom Ltd.
Denison Mines Ltd.
Noranda Mines Ltd.
Gulf Minerals Canada Ltd.

Australia
Queensland Mines Ltd.
Pancontinental Mining Ltd.
Conzinc Riotinto of Australia Ltd.
Mary Kathleen Uranium Ltd.

South Africa
Nuclear Fuels Corp. of S.A. Ltd. (NUFCOR)
Anglo American Corp. of S.A. Ltd.

UK
Rio Tinto-Zinc Corp. Ltd.
RTZ Services Ltd.

Contention: Westinghouse has charged the defendants with antitrust violations and seeks treble camages of an unspecified amount.

Status: Charges against Reserve Oil and Minerals Corp. and Rio Tinto Zinc Corp. have been dismissed.

Settlements have been concluded with four others: Homestake, Getty, Gulf Oil and Gulf Minerals Canada. As of this writing, an agreement in principle has been announced between Westinghouse and Kerr McGee. Of the remaining defendants, nine have not appeared, and Westinghouse is seeking a default judgment against them. The nine include all non-US defendants except Denison and Noranda. The trial is scheduled to begin September 1981.

Several of the defendants, including Western Nuclear, Kerr-McGee, Atlas, Anaconda and Utah International have filed counter claims against Westinghouse alleging various forms of anti-competitive conduct and seeking trebled damages of an unspecified amount.

TVA—Producers

This case was initiated in 1977 and involves TVA as plaintiff in a multi-district proceeding in Chicago, Illinois, where discovery has been combined with the

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Chicago Westinghouse case. Defendants are 13 US and foreign entities as follows:

US
Rio Algom Corp.
Englehard Minerals and Chemical Corp.
Gulf Oil Corp.

Canada
Gulf Minerals Canada Ltd.
Rio Algom Ltd.
Denison Mines Ltd.
Noranda Mines Ltd.
Uranerz Canada Ltd.

South Africa
NUFCOR

UK
Rio Tinto-Zinc Corp. Ltd.
RTZ Services Ltd.

Germany
Urangesellschaft GmbH

France
Uranex

Contention: TVA has charged the defendants with antitrust violations and is seeking trebled damages of an unspecified amount.

Status: No trial date has been set as yet.

Reserve/Sohio—Gulf This suit was filed in September 1977 in New Mexico by Reserve Oil and Minerals Corp. as plaintiff against Gulf, General Atomic and Scallop Nuclear. Sohio subsequently joined the case as a plaintiff.

Contentions: Reserve and Sohio have charged the defendants with antitrust violations and seeking monetary damages and a determination that a 1975 uranium supply contract involving 5.5 million pounds U_3O_8 is invalid. The defendants have filed a counterclaim asking either that the contract be enforced or that they be awarded damages for nondelivery as well as punitive damages.

Status: Discovery ongoing, and no trial date has yet been set.

Exxon—GPU

This case was filed in early 1979 and involves Exxon as plaintiff and General Public Utilities as defendant in a dispute over a contract option covering U_3O_8 for nine reload batches of fuel.

Contentions: Exxon contends that its obligation to supply U_3O_8 to GPU ended in 1975. Exxon is seeking a declaratory judgment that it has no obligation to delivery U_3O_8, as well as damages representing the difference between the price received and market price for the first three batches of U_3O_8 delivered under the option in 1976, 1977 and 1978. In a counterclaim, GPU asks a declaratory judgment that the option was accepted properly and constitutes an enforceable contract.

Status: Suit is still in the discovery phase. A pretrial hearing is scheduled for May 1981 at which time it is anticipated that a trial date will be set.

Bokum—Lilco

This case involves a uranium mine and mill financing agreement between Bokum Resources Corp. and Long Island Lighting Co. (Lilco).

Contention: Lilco contends that Bokum is in default of its financial and other obligations and seeks title to Bokum's mine and mill. Bokum has filed a counterclaim alleging that Lilco interferred with, and prevented the consummation of, a prospective takeover of Bokum by Occidental Petroleum. Bokum is also seeking damages.

Status: Lilco's suit and Bokum's counterclaim have been consolidated in the U.S. District Court in Albuquerque, New Mexico.

General Atomic—Exxon

This action was filed by General Atomic as plaintiff against Exxon in early 1978 and involves a dispute over a six million pound uranium supply agreement.

Contentions: General Atomic sued Exxon for breach of contract and seeks either specific performance of the contract or damages for nonperformance. Exxon filed a counterclaim against General Atomic, Gulf Oil and Scallop Nuclear alleging antitrust violations. Exxon is seeking trebled damages of an unspecified amount and a declaratory judgment that the contract is void.

Status: Trial is currently scheduled to begin in April 1981.

Getty—Two Utility Groups

This case was initiated in January 1981 and involves Getty Oil and two groups of utilities which had contracted to purchase U_3O_8 from Getty. The plaintiff is Getty; the defendants are a group of four Wisconsin utilities including Wisconsin Electric Power Co. and Wisconsin Public Service Co. and a group of New

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URANIUM MARKET

England utilities comprising Public Service Co. of New Hampshire and other owners of the Seabrook nuclear project.

Contention: Getty has charged the utilities with contract default and antitrust violations and seeks damages and a determination that the contract is valid and enforceable. The utilities have filed a counterclaim against Getty alleging antitrust violations and seeking treble damages of an unspecified amount, dismissal of Getty's suit and a determination that they be relieved of the obligation to purchase uranium from Getty.

Status: Suit recently initiated.

Two Utility Groups—12 Uranium Companies

This is a case filed in Chicago, Illinois, on January 30, 1981 by the Wisconsin and New England utility groups involved in the Getty litigation as plaintiffs against the following as defendants:

US
Getty Oil Corp.
Gulf Oil Corp.
Homestake Mining Co.
Atlas Corp.
Anaconda Co.
Utah International Inc.
Kerr McGee Corp.
Phelps Dodge Corp.
Western Nuclear Corp.
United Nuclear Corp.

Canada
Gulf Minerals Canada Ltd.

Australia
Pancontinental Mining Ltd.

Contention: The utilities have charged the defendants with antitrust violations and are seeking trebled damages of an unspecified amount.

Status: Suit recently initiated.

A number of previously decided suits are currently under appeal. A major dispute over the supply of some 27 million pounds of U_3O_8 involves United Nuclear and General Atomic. A default judgment against General Atomic by the New Mexico state trial court was affirmed by the New Mexico Supreme Court. General Atomic has asked for review by the US Supreme Court; The Supreme Court has not yet responded to the request for review. An arbitration award in favor of General Atomic against United Nuclear has been set aside in the New Mexico court and is being appealed by General Atomic. Other suits that are still under appeal include Atlas—Iowa Electric and Homestake—Washington Public Power Supply System (WPPSS).

There have been a number of major suits settled over the past few years, including: WPPSS—Kerr McGee; Ranchers Exploration and Development Corporation—General Atomic; Kerr McGee—CAPCO Group; Pennsylvania Power & Light—General Atomic; Boston Edison—Atlas; and Carolina Power & Light—Uranex.

Recently, WPPSS requested assurances from Exxon that it would honor two uranium supply contracts signed in the early 1970's. This action by WPPSS is the outflow of a letter from Exxon stating that those contracts are "unenforceable." The contracts are in connection with reload fuel for the WNP-2 and WNP-3 nuclear units.

CANADA

The Key Lake Board of Inquiry, appointed in December 1979 to make recommendations regarding resource development in the Key Lake area of Saskatchewan, has recently published the report of its findings. Following is a summary of the Key Lake Development as presented by the Board. A discussion of the findings of the Board and its recommendations will appear in Nuexco Report 152.

The Key Lake project involves the construction and operation of a uranium mine and mill in the central area of northern Saskatchewan. It is being developed by the Saskatchewan Uranium Joint Venture, which is owned by Saskatchewan Mining Development Corporation (one-half), Uranerz Exploration and Mining Limited (one-third) and Eldor Resources Limited (one sixth). On March 1, 1979, the owners formed Key Lake Mining Corporation (KLMC) to bring the mine and mill into production and to operate the facilities. KLMC is also responsible for exploration on the mineral lease surrounding the two orebodies discovered to date. SMDC is a Crown Corporation owned by the Government of Saskatchewan. The Corporation was established in 1974 to participate in

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the development of the hard-rock mineral sector of the province's resources industry.

The uranium at Key Lake is contained in two orebodies, known as the Gaertner and the Deilmann deposits. Both are long and narrow, covering a cumulative length of approximately 2.6 km. The orebodies are relatively close to the surface and are covered partially by small lakes and by 20 to 100 meters of earth deposited by glaciers.

The Gaertner deposit was discovered by the joint venture in August, 1975 and is approximately 80 meters wide and 50 meters in thickness. The Deilmann orebody was discovered in July, 1976 and is approximately 200 meters wide and up to 160 meters in thickness. These orebodies have an average grade of about 2.5 percent U_3O_8. Reasonably assured resources at Key Lake are estimated to be in excess of 150 million pounds U_3O_8. The proposed project at Key Lake involves the development of an open pit operation for each of the two orebodies.

The mining of ore at Key Lake is proposed to begin in 1983 and will continue until at least 1998. Ore removal is scheduled to begin about six months before startup of the mill. Mill startup will probably be in late 1983 or early 1984.

The annual mill capacity of the project will be at least eight million pounds U_3O_8, and may be as high as 12 million pounds, depending upon market conditions.

FAR EAST

Japan's Ministry of International Trade and Industry (MITI) has already called into question the recently established official target of having at least 51,000 MWe of nuclear capacity on line by the end of 1990. (See Nuexco Report 149.) The internal MITI report concludes that unless the present siting and related licensing problems are resolved, 1990 nuclear capacity is unlikely to exceed 45,000 MWe, thus eventually requiring a downward revision of the official target.

PNC of Japan has announced that it intends, during the fiscal year beginning April 1, 1981, to spend nearly US $25 million in its continuing program of uranium exploration. Both venture independent and joint projects are planned in various areas including Niger, northern Saskatchewan (with SMDC), the United States (with Conoco), Zambia, Gabon, and Australia (with Pancontinental), among others. While concentrating in countries and areas of known potential, PNC is also actively looking into frontier areas with the hope that new finds will further add to supply security.

Recent Australian-Japanese ministerial meetings in Tokyo highlighted not only the benefits, but also the potential frustrations and problems for the two partners in resources trade. As a supplier, Australia called on Japan to provide realistic data on future coal demand. The Australians emphasized that new coal development was contingent upon Australian confidence about future demand, as well as reasonable prices. A similar Australian attitude no doubt exists with respect to uranium, but is complicated by foreign policy considerations, such as the necessity of negotiating a new bilateral safeguards agreement, and by additional commercial considerations such as Australian desires to enter the enrichment business. The Australian enrichment plans may conflict with steady Japanese progress in developing their centrifuge technology, a key ingredient of nuclear independence. Thus, the normally straightforward buyer/seller relationship is entangled with the political, economic and foreign policy goals of each country and may result in transactions which appear at variance with market parameters determined solely by supply and demand.

UNITED STATES

US utilities continue to experience the effects of the March 28, 1979 accident at Three Mile Island. The USNRC now anticipates additional delays in the licensing process for construction and operation of new US nuclear power plants. The licensing setbacks from TMI began on May 21, 1979 when the NRC staff reported that no new operating licenses or construction permits would be issued for nuclear plants for at least three months. This policy was extended in early October 1979 by the adoption of an interim licensing policy which allowed licensing hearings to continue in certain cases but which limited the issuance of licenses during the reassessment of the NRC's structure and regulatory authority.

In February 1980, the NRC approved a list of 38 new requirements for issuance of an operating license and soon thereafter lifted its year-long licensing moratorium with the granting of a *near term* operating license to TVA for Sequoyah unit 1. This type of

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license authorizes fuel loading and zero power testing and includes a provision for five percent power testing contingent on additional approval by the NRC office of Nuclear Reactor Regulation.

Since then, similar licenses have been issued to Virginia Electric & Power Co. for North Anna unit 2 and Public Service Electric & Gas Co. for Salem unit 2. North Anna unit 2 began commercial operation in December 1980. Salem unit 2 is scheduled to receive a full power license during 1981. Alabama Power Company's Farley unit 2 was granted a low-power license in early September 1980 but the plant has not yet begun fuel loading.

The most recent licensing event was the January 23, 1981 issuance of a zero power testing license to Duke Power Company for McGuire unit 1. A full power license for McGuire could be delayed by the reopening of hearings.

Sequoyah unit 1 received the first full power operating license since TMI on September 16, 1980. The license was conditional as it had several attached stipulations mainly dealing with testing of the hydrogen control system in the ice condenser containment structure. Sequoyah unit 1 will be allowed to operate under this conditional license for another year, pushing a commercial operation date to some time beyond January 1982.

Although 1980 saw the resumption of licensing action, recent NRC statements have dampened any enthusiasm which might have been stimulated by the lifting of the licensing moratorium.

The NRC presently anticipates that operating licenses will be issued during 1981 only for Salem unit 2, Farley unit 2, LaSalle unit 1 (Commonwealth Edison) and Sequoyah unit 2. The NRC cites extended hearings and additional elapsed time between the close of hearings and the issuance of Licensing Board rulings for pushing licensing decisions into 1982 and 1983.

Applications for construction permits are affected by similar problems and have been relegated to a secondary priority by the NRC. The first post-TMI construction permit is not expected before mid-1982.

Table 1 chronicles the changes over the past two years in estimated reactor startup schedules. In view of the latest NRC statements, even the most recent forecasts of startup dates are questionable. Recent announcements of licensing delays add increased uncertainty to forecasts of commercial operating dates.

In addition to the plants mentioned above, the facilities most likely to be affected by the licensing slowdown are: Diablo Canyon units 1 and 2, San Onofre unit 2; Sumner; Zimmer; Susquehanna unit 1;

Table 1

ESTIMATED COMMERCIAL OPERATION TIMES FOR NEW US NUCLEAR POWER PLANTS

(number of units per year)

Year of Commercial Operation	Time of Estimate: Before TMI	Six Months After TMI	Feb 1981 Nuclear News	Nuexco Report 147	Current Nuexco Estimate
1979	9	3	1	1	1
1980	10	11	2	1	1
1981	11	7	7	3	2
1982	13	10	9	5	3
1983	10	10	15	5	5
1984	8	9	9	6	5
TOTALS	61	50	43	21	17

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Comanche Peak unit 1; Waterford unit 3; Shoreham; and Fermi unit 2.

Of the plants referred to in this section, Nuexco believes the breakdown by year will be two plants going into commercial operation in 1981, three in 1982, five in 1983, five in 1984, and one in 1985.

TRANSACTIONS

Two material transactions are reported this month. The first involves the sale of between 50 and 100 thousand pounds U_3O_8 from a US producer to a US utility for delivery later this year. The second is a sale of between 300 and 600 thousand pounds U_3O_8 by a US utility to another US company for delivery in 1981. The prices in both transactions were related to market price at the time of delivery.

Several major transactions are under negotiation at this time. Some of the details of these transactions are tabulated in Table 2. The total quantity involved in the four transactions is about ten million pounds U_3O_8, indicating the resurgence of interest in longer term material. It is noteworthy that base price escalated deals are being discussed in some cases as well as market related contracts.

Table 2

PENDING TRANSACTIONS

Nuexco Reference Number	Approx. Quantity (millions of pounds U_3O_8)	Approx. Price (percent of E V.)
1253	2 to 4	market related
1289	1 to 2	market related
1305	2 to 4	100
1373	2 to 4	100

The **Transaction Value** remained at $27.20 per pound U_3O_8, unchanged from last month. No new qualifying transactions closed, so the Transaction Value sample remained unchanged.

PRICING

The **Exchange Value** remained at $25.00 per pound U_3O_8, unchanged from last month. The most important factors involved in the Exchange Value's remaining at the $25.00 level include:

1. A large amount of material is currently under negotiation at prices about equal to current Exchange Value.
2. Many sellers are now offering material at about current Exchange Value. For the most part, they are waiting for buyers' responses rather than aggressively discounting prices in order to make sales.
3. There are indications that substantial new near term demand might come into the market as producer-buyers continue to evaluate their options at this price level.

Near term material now available for sale, as listed in the *Market Opportunities* section of this Report, totals 8.5 million pounds U_3O_8. Active inquiries to purchase amount to 900,000 pounds U_3O_8. Lower prices would normally be expected to remove some of the available supply from the market, however the reverse has apparently happened. Many sellers have followed the market down and are still interested in selling at today's prices; others have recently entered or re-entered the market. Available near term supply is now at its highest level in recent years. Approximately 45 percent of this near term material is being offered by primary producers; the balance is being offered by inventory holders.

CONVERSION

This month has seen increased activity in the longer term secondary market for conversion services. Utilities in need of long term conversion supply are exploring opportunities to purchase conversion from other utilities holding excess supplies under contract. As indicated in the Market Opportunities section of this Report inquiries to sell conversion services in the near term secondary market totaled 4.1 million pounds U as UF_6. Inquiries to purchase conversion services in the same time frame amounted to 1.4 million pounds U as UF_6. Thus the near term market is one of oversupply, dominated by UF_6 inventory holders wishing to move material through "deconverting" it to concentrates. On the other hand, the longer term market shows more demand than available supply.

The **Conversion Value** remained constant at $1.20 per pound U as UF_6. There is one pending transaction between two US utilities for secondary conversion services at a price close to Conversion Value.

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TOPICAL ESSAY

WORLD DEMAND: PART I, THE US

Demand in the uranium industry is a concept that has proved difficult to define and even more difficult to calculate. From time to time, Nuexco has published a series of figures called Apparent Future Consumption (AFC), which frequently have been mistaken for demand. These AFC figures were most recently updated in Nuexco Report 147. However, AFC is quite different from demand; AFC is merely a subset of demand. This essay treats Nuexco's estimate of uranium demand in the US. It also discusses in detail the distinction between AFC and demand.

Apparent Future Consumption is Nuexco's estimate of that portion of demand which corresponds to reactor requirements. That is, if the uranium industry were in a market environment such that price, security of supply and political influences were not considerations, material would be required in the quantity and on the time schedule of AFC in order to keep the reactors running under the assumed conditions.

AFC is a computation of the amount of U_3O_8 which would be used to fabricate fuel for loading and reloading reactors operating, under construction or on order. It is compiled and computed on a reactor by reactor basis, with the quantities for each reactor being based on specific core characteristics, 0.25% tails assay, no recycling, 24 month lead time for procuring first cores and 18 month lead time for procuring each reload. Where reload schedules are unknown, it is assumed that reloads occur one year after commercial operating date and annually thereafter. Nuexco estimates of individual reactor capacity factors are used.

Demand, on the other hand, includes the effects of price, security of supply and political influences; more accurately, it includes the buyers' perceptions of these factors. Demand, as defined by Nuexco, refers to buyers' stated, or otherwise indicated, willingness to buy uranium now or at some time in the future.

Differences between the two for any individual utility could be significant:

1. A utility could choose to reduce inventory by procuring less uranium than needed for its reactors. Thus demand for that utility would be less than AFC.

2. A buyer could choose to increase inventory by buying more than required for current needs, simply to enhance security of supply.

3. Utilities frequently plan their procurement strategies to achieve a very high probability of obtaining at least enough uranium to meet commitments as they arise, so they tend to procure more than actually required for current needs. For example, utility buyers often assume a higher-than-expected capacity factor, and a sooner-than-expected need date.

4. A buyer's obligation to a supplier of fuel cycle services such as conversion, enrichment or fabrication may require earlier purchase of uranium than a reactor's operating schedule would otherwise require.

The uranium demand for US electric utilities is carried in the Nuexco data base as an individual entry for each reactor. The entries are then grouped by utility. These data are continuously updated to reflect changes in each utility's situation. The amount of uranium a utility might be willing to purchase is a function of several variables, any one of which can change enough to reverse a previous decision to buy or wait. For example:

1. A utility may perceive its need for uranium based on internally generated estimates of requirements. A construction delay could cause the utility to defer procurement plans to keep pace with the construction. This variable could also change as the result of outside factors such as a change in tails assay, estimated capacity factor, or fuel exposure.

2. A utility's view of the need for security of supply may change as the world uranium supply picture evolves, and the utility may alter its demand schedule accordingly. In the mid-1970's, when supply appeared short, many utilities became concerned with their lack of assured supply, and aggregate demand increased well above AFC, particularly over the short term. Now that a uranium shortage appears unlikely, some utilities have elected to maintain a zero inventory policy, confident that even if a uranium shortage did occur, their needs would be met by other utilities holding large inventories or by the government.

3. Changes may occur in a utility's perception of its supply already under contract. If a quantity of uranium previously thought to be secured by contract becomes unavailable through renegotiation or litigation, the utility's demand could suddenly increase even though its AFC had not changed.

The aggregate figures for US utility demand, US utility demand less AFC, US utility unfilled demand,

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and US unsold production are tabulated in Tables 3, 4, 5 and 6 respectively, through 1990. The definition of and methodology involved in determining the numbers in Table 3 are discussed above. Table 4 shows the degree to which utility demand exceeds the AFC published in Nuexco Report 147; generally demand is some 50% higher than AFC. This reflects utility caution and desire for security of supply.

Unfilled demand (Table 5) are simply the sum of each utility's demand less material under contract. This is calculated on a utility by utility basis rather than adding all the utility demand and subtracting all the contracted supply. Finally, US unsold production (Table 6) is that portion of Nuexco's estimate of total US production, also published in Report 147, which has not yet been contractually committed. Note that US uncommitted *capacity* is significantly larger than estimated unsold production.

AFC is the component of demand which can be empirically derived and evaluated. But demand is more complex than that, for it encompasses the unquantifiable market perceptions of the buyers. In the final analysis, it is demand, and not AFC, which directly impacts on the uranium market at any given time.

Non-US demand and the implications of the differences between demand and AFC will be disucssed further in subsequent Nuexco Reports.

Table 3
US UTILITY DEMAND
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual:	36.6	37.3	42.4	48.3	52.9	55.9	55.9	56.9	57.5	57.3
Cumulative:	36.6	73.9	116.3	164.6	217.5	273.4	329.3	386.2	443.7	501.0

Table 4
US UTILITY DEMAND LESS AFC
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual:	15.7	14.4	15.3	17.9	20.1	20.4	20.8	19.3	17.1	17.0
Cumulative:	15.7	30.1	45.4	63.3	83.4	103.8	124.6	143.9	161.0	178.0

Table 5
US UTILITY UNFILLED DEMAND
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual:	0.3	1.5	4.4	6.4	12.3	14.9	23.8	28.9	33.6	36.3
Cumulative:	0.3	1.8	6.2	12.6	24.9	39.8	63.6	92.5	126.1	162.4

Table 6
US UNSOLD PRODUCTION
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual:	5.3	3.3	3.9	4.6	3.5	6.8	7.7	8.4	10.1	10.2
Cumulative:	5.3	8.6	12.5	17.1	20.6	27.4	35.1	43.5	53.6	63.8

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RAW MATERIALS

SOUTH TEXAS DISTRICT—PART II

Host-Rock Geology

The Tertiary formations of South Texas were deposited in a coastal marine and continental environment. The uranium-bearing formations consist of thick tuffaceous and clay units (the Fant Tuff and Frio Clay); sandstone units (Oakville, Tordilla, Deweesville and Dillworth); and fine to coarse-grained sandstone and conglomeratic units (Goliad and Soledad). The entire sequence is characterized by socillating depositional patterns marked by facies changes which commonly include any combination of formational deposit. Carbonaceous material and lignite may occur in light to heavy concentrations throughout the more sandy units. The predominant depositional patterns of the Eocene formations are related to beach and barrier-bar structures; the younger formations are associated with continental deposition consisting of fine to coarse sand and conglomeratic units. The source of the fine to coarse sand and conglomeratic material may have originated in West Texas and northern Mexico; and the tuffs were deposited during regional volcanic activity.

Uranium mineralization is commonly found in sand and sand/mud facies filling erosional channels, and in well defined beach and barrier-bar structures. The most important ore deposits are associated with depositional changes in fluvial channel environments. A greater concentration of uranium often occurs where lignite and carbonaceous material are abundantly dispersed throughout sand units, especially where permeability is relatively high. There is also an apparent relationship between the concentrations of uranium and clay minerals present in certain sand/clay host units. The clay particles acted to restrict the normal flow of mineral bearing solutions and consequently afforded the rapid precipitation of uranium, enriching the clay-bearing unit. It was concluded that the uranium deposits of the district were formed by epigenetic process—placement of the uranium occurred after and totally independent of the deposition of the host formation.

The unoxidized uranium deposits of the district are significantly larger than were the oxidized deposits mined in the 1960's. Unoxidized mineralization has notably formed in anomalous concentrations along sinuous alteration fronts, or roll fronts, similar to deposits in the Tertiary rocks of Wyoming. Low-grade uranium may occur continuously for several miles along a front; however, the higher grade uranium usually occurs as discrete accumulations randomly distributed along the roll front. Molybdenum, selenium and arsenic occur as accessory minerals to the uranium in certain areas throughout the district. The accessory minerals can be useful as an exploration guide under cetain circumstances. Organic material, pyrite and clay minerals are common constituents associated with uranium.

The principal source of uranium mineralization is considered to be the thick volcanic ash (tuff) sequence of Miocene Age that covered the entire region. As the tuff formation eroded, primaraily toward the gulf, the contained uranium was leached from the tuff to be absorbed and transported downdip by oxygenated ground water. Precipitation of the uranium in a favorable host rock occurred in a reducing environment. The reducing environment was probably created by the upward migration of hydrogen sulfide and/or methane gas associated with deeper deposits of oil and gas. Formation permeability and faulting are the main factors controlling the migration of the reductants to the surface; thus offering a guide to exploration.

The ore minerals common to the district are both oxidized and unoxidized. The first mining was from shallow open pit mines (average depth about 40 feet) situated along a trend from Deweesville, through Tordilla Hill, and into Live Oak County. About 200,000 tons of ore averaging 0.20 percent U_3O_8 were mined between 1960 and 1964, nearly all of which was oxidized. The principle uranium minerals were autunite a calcium phosphate of uranium, and tyuyamunite—a calcium, uranium vanadate. Carnotite—a uranium vanadate, was present in minor amounts. Trace amounts of unoxidized mineral uraninite—a uranium oxide, was noted in isolated occurrences, usually in the lower contact portion of the deposit.

The Mabel New deposit was the only important oxidized deposit mined in Live Oak County. The average depth of the deposit was 90 feet, about 50 feet deeper than the oxidized deposits near Deweesville. The characteristics of Mabel New ore were completely different from other deposits. The ore minerals were boltwoodite—a uranium potassium silicate, and weeksite—a uranium potassium silicate high in calcium. The ore occurred as a bedded deposit in a host rock of ferruginous sandstone. The deposit was

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enclosed in a thin bed of fine-grained sandstone tightly cemented by calcite. It was the only deposit of this type in the district.

Unoxidized mineralization was discovered one to two miles downdip from the oxidized deposits in Karnes County in 1963. The principal host for such ores is fine-grained arkosic sandstone and clayey sandstone in beach environment and fluvial channel fill. Most of the unoxidized ore occurs in roll front-type deposits, with the unoxidized zone and the thickest and richest ore on the downdip side of the front. The main ore minerals are uraninite—a uranium oxide, and coffinite—a uranium silicate. Associated minerals consist of molybdenum, selenium and pyrite. The largest and most important ore deposits along the trend are completely unoxidized and occur in the Oakville Sandstone in Live Oak County.

Roll front deposits in sandstone facies of fluvial channels within the Soledad member of the Catahoula Tuff are important in Duval and Webb County. Ore grade mineralization is known to occur at depths of 2,000 feet or more in the Oakville and Catahoula formations; however, the deepest solution mining is currently between 600 and 700 feet. Due to the depth and low grade nature of certain deposits, in situ solution mining is considered the most practical method of recovery. Table 7 illustrates the geologic sequence of all uranium-bearing formations with relation to rated economic importance of each formation and the main area of mining activity.

Generally, the oxidized ores were characterized by an equilibrium difference bewteen detectable radiation and actual uranium content of the ore. Detailed evaluation of a deposit by core drilling and chemical assaying of samples became an important procedure in final orebody studies. Exploitation of a deposit was dependent upon the proper interpretation of the disequilibrium factor. The problem of disequilibrium in unoxidized ore deposits has been minor to non-existent; even so, project evaluation procedures usually include precautionary measures such as core

Table 7

GEOLOGIC SEQUENCE OF THE URANIUM-BEARING FORMATIONS IN THE SOUTH TEXAS DISTRICT RATED BY ECONOMIC IMPORTANCE OF URANIUM DEPOSITS AND SHOWING THE PRINCIPAL AREAS BY COUNTIES.

Geologic Age	Geologic Unit	Economic Rank	County
Pliocene	Goliad Sandstone	4	Live Oak, Duval
Miocene	Fleming Formation		
	Oakville Sandstone	1	Karnes, Live Oak, McMullen, Duval, Jim Hogg, Dewitt
Oligocene	Catahoula		
	Chusa Tuff		
	Soledad Conglomerate	2	Duval, Webb
	Fant Tuff	5	Live Oak, Duval
	Frio Clay	6	Live Oak
Eocene	Jackson Group		
	(Whitsett Formation)		
	Fashing Clay		
	Tordilla Sandstone	3	Karnes, Wilson, Atascosa
	Dubose		
	Deweesville Sandstone	3	Karnes, Gonzales, Wilson, Fayette
	Conquista Clay		
	Dilworth Sandstone	6	Karnes

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drilling and chemical assaying of core samples to determine if an equilibrium problem exists and what must be done to compensate for it.

Mining Activities

Approximately 6.7 million pounds U_3O_8 were produced in the South Texas district during 1980, making it the third largest production center in the US. Over 3.1 million pounds U_3O_8 were produced by open pit mining and conventional milling and about 3.6 million pounds by in situ solution mining techniques. In all, the South Texas district has existing production capacity for a total of at least nine to ten million pounds U_3O_8. However, it is unlikely that production for the next few years will exceed the 1980 level. Conventional production centers have already curtailed operations, or have plans to do so, and more than two-thirds of the 13 in situ solution mining projects are operating below design capacity.

The largest conventional mining and milling operation in the district is the Conquista project which is controlled by Conoco and Pioneer Nuclear. Conoco is project operator. A 3,500 ton per day mill located at Deweesville, Karnes County is the center of activity. As of January 1981, project operations included 12 active mines in various stages of stripping, mining and pit reclamation in Karnes, Live Oak and Gonzales Counties. Operating depths are from 120 to 200 feet. (Figure 1 shows the stripping procedure at one of the Conquista projects.) Conquista currently has 27 active mining permits out of a total 36 issued to date. Even though project operations were curtailed 50 to 60 percent on January 1, permit number 37 for another open pit mine is pending. Past mining from the Whitsett formations has occurred in Wilson, Dewitt and Atascosa Counties. Figure 2 is a photo of the specialized equipment used by Conquista for mining ore.

Chevron Resources Company operates a 3,000 ton per day mill located at Panna Maria in eastern Karnes County. Mill feed is mined from three open pit mines at depths of 120 feet to 180 feet in the Whitsett sandstone units. Chevron has also applied for a mining permit on the Jack Pump ore deposit located about 16 miles northeat of the Panna Maria mill site. In a significant move to enhance uranium operations in the district, Chevron announced in December 1980 that it had signed a letter of intent with Union Carbide Corporation for the purpose of purchasing all mineral interest controlled by UCC on the Palangana and Rogers properties. It is contemplated that the ore reserves on the Rogers lease could be mined by open pit methods; the Palangana deposit will probably be mined by open pit methods; the Palangana deposit will probably be mined by in situ solution methods.

The Anaconda et al joint venture has proposed an open-pit mine and conventional mill for the large ore deposit located on the Rhode Ranch in McMullen County. The original proposal indicated the mine and mill would support a production rate of 2,000 tons per day. However, it was announced in December 1980 that the project would be delayed indefinitely, pending improved market conditions for uranium. All property evaluation was discontinued at that time.

In situ solution mining, or in situ leaching, technology has advanced rapidly since it was first tested in the district about 1968. It is a highly sophisticated recovery method today, applied by 18 different companies or joint ventures at 14 fully operational in situ leach projects. One pilot plant is operating, two additional plants are under construction, three are in the permitting stage and one more has been proposed. Figure 3 shows the location, project status and ownership of each mining property along the mineral trend.

Uranium recovery for each plant is a function of the flow-through rate of lixiviant given in gallons per minute times the concentration of uranium in the feed. The recovery of uranium from the lixiviant is incidental to the actual leaching process. Throughput of a full production plant varies from about 500 gpm to about 10,000 gpm. Pilot plant operations are usually designed for initial flow below 200 gpm subject to one or two incremental increases to attain the desired throughput level. Upgrading a plant from the pilot stage to a satisfactory production level can be accomplished in six to nine months, depending upon testing time and required process modifications.

Actual U_3O_8 production by in situ solution mining for 1980 varied from less than 50,000 pounds U_3O_8 at the smaller operations to about one million pounds at the largest operations. The average production rate in 1980 for each of the 13 in situ plants was 257,000 pounds U_3O_8. One of the smaller operations is producing U_3O_8 by a modified in situ solution mining technique. Solution Engineering, Inc. is engaged in reclamation of residual uranium from impounded mill tailings at the Susquehanna Western, Inc. site near Falls City. The tailings are being treated by a

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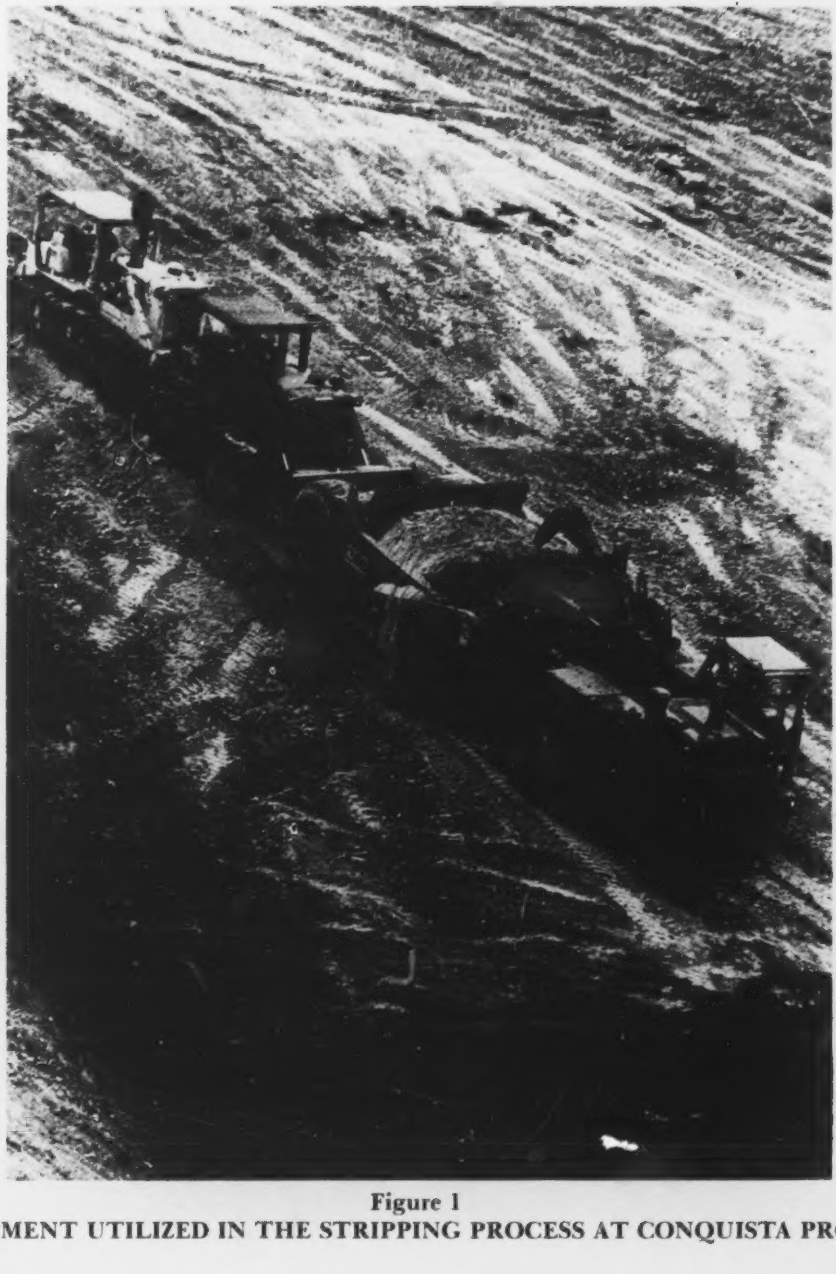

Figure 1
HEAVY EQUIPMENT UTILIZED IN THE STRIPPING PROCESS AT CONQUISTA PROJECT MINES

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Figure 2
SPECIALIZED EQUIPMENT USED FOR ORE REMOVAL AT CONQUISTA PROJECT MINES

method called as in situ heap leaching.

Leaching solution contact with the tailings a manner similar to conventional in situ solution mining. Well patterns are strategically located over the tailings to service the area to be leached.

The residual acid content of the tailings provides the leaching agent which extracts already soluble uranium from the porous tailings. Feed to the recovery plant varies with the areas being leached, but generally contains 20 to 40 parts per million U_3O_8. The recovery plant has a capacity of 800 gpm featuring a countercurrent continuous ion exchange system and subsequent system to produce dry yellowcake.

Summary

Participation in exploration and development throughout the South Texas district has continued to gain favor because of exploration success and workable industry regulations. Several distinct mineral trends have been developed to date and new trends have been discovered at greater depths. Drilled reserves of the district are estimated by Nuexco at 140 million pounds U_3O_8; the potential to increase reserves by 50 percent is considered good to excellent. The new trend developing in the Oakville Sandstone through Jim Wells and the eastern part of Duval Counties has much potential. It is inevitable that exploration efforts will migrate eastward to test each uranium-bearing formation at ever-increasing depths.

New property development is completely under the jurisdiction of state agencies. The Railroad Commission of Texas is primarily responsible for open-pit mines; the Texas Department of Water Resources has the responsibility for in situ solution mining; the Department of Health and the Air Control Board contribute to final environmental requirements. Texas is an Agreement State and the Nuclear Regulatory Commission and the Environmental Protection Agency have only indirect jurisdiction. State agencies work in close cooperation with the industry to allow exploitation of uranium deposits. As a result, development of new properties has been steady during the last few years and the district has become one of the most active in the US.

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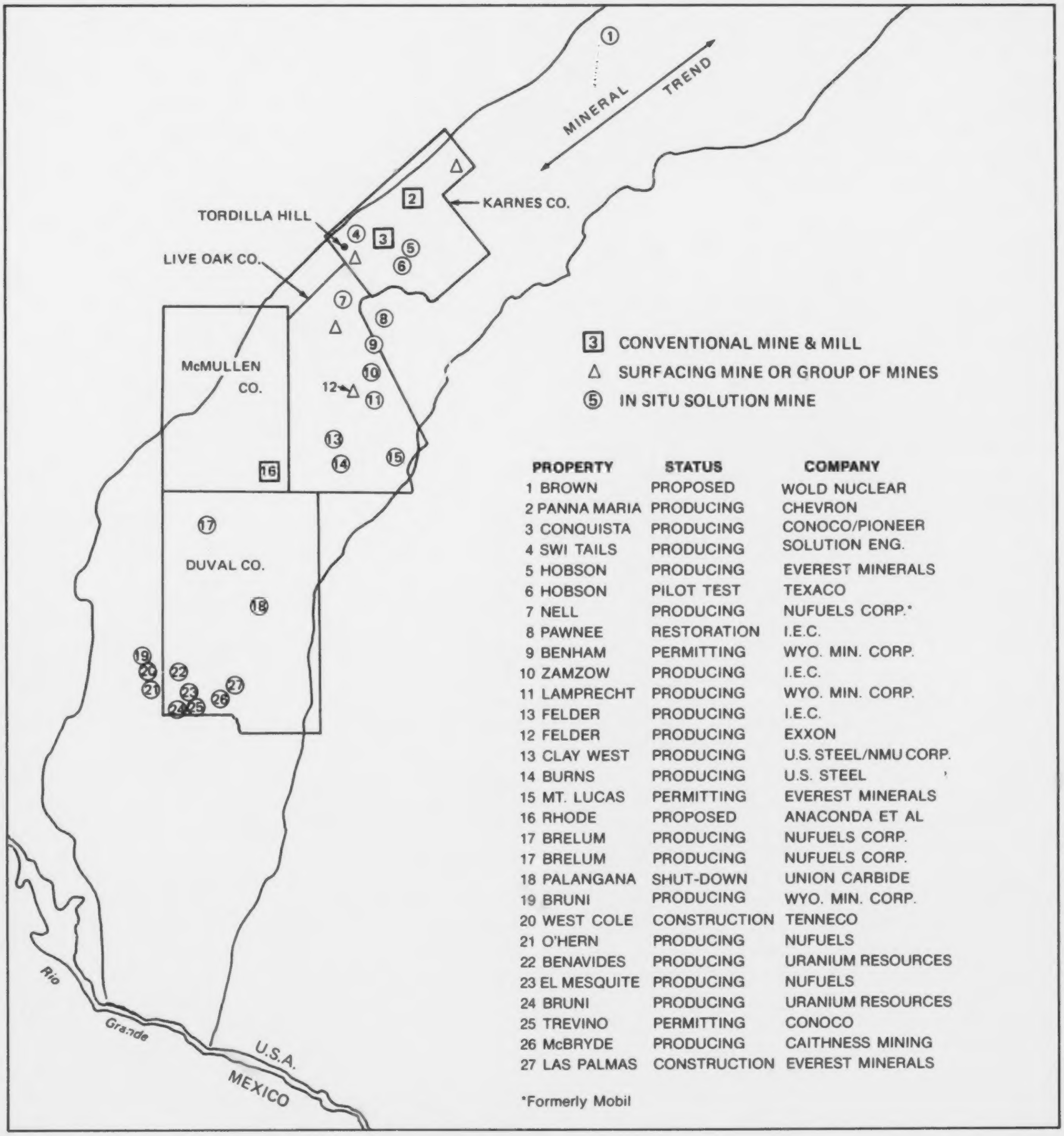
RAW MATERIALS


MINERAL TREND
KARNES CO.
TORDILLA HILL
LIVE OAK CO.
McMULLEN CO.
DUVAL CO.
Rio Grande
U.S.A.
MEXICO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
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16
17
18
19
20
21
22
23
24
25
26
27
3 CONVENTIONAL MINE & MILL
△ SURFACING MINE OR GROUP OF MINES
⑤ IN SITU SOLUTION MINE

PROPERTY	STATUS	COMPANY
1 BROWN	PROPOSED	WOLD NUCLEAR
2 PANNA MARIA	PRODUCING	CHEVRON
3 CONQUISTA	PRODUCING	CONOCO/PIONEER
4 SWI TAILS	PRODUCING	SOLUTION ENG.
5 HOBSON	PRODUCING	EVEREST MINERALS
6 HOBSON	PILOT TEST	TEXACO
7 NELL	PRODUCING	NUFUELS CORP.*
8 PAWNEE	RESTORATION	I.E.C.
9 BENHAM	PERMITTING	WYO. MIN. CORP.
10 ZAMZOW	PRODUCING	I.E.C.
11 LAMPRECHT	PRODUCING	WYO. MIN. CORP.
13 FELDER	PRODUCING	I.E.C.
12 FELDER	PRODUCING	EXXON
13 CLAY WEST	PRODUCING	U.S. STEEL/NMU CORP.
14 BURNS	PRODUCING	U.S. STEEL
15 MT. LUCAS	PERMITTING	EVEREST MINERALS
16 RHODE	PROPOSED	ANACONDA ET AL
17 BRELUM	PRODUCING	NUFUELS CORP.
17 BRELUM	PRODUCING	NUFUELS CORP.
18 PALANGANA	SHUT-DOWN	UNION CARBIDE
19 BRUNI	PRODUCING	WYO. MIN. CORP.
20 WEST COLE	CONSTRUCTION	TENNECO
21 O'HERN	PRODUCING	NUFUELS
22 BENAVIDES	PRODUCING	URANIUM RESOURCES
23 EL MESQUITE	PRODUCING	NUFUELS
24 BRUNI	PRODUCING	URANIUM RESOURCES
25 TREVINO	PERMITTING	CONOCO
26 McBRYDE	PRODUCING	CAITHNESS MINING
27 LAS PALMAS	CONSTRUCTION	EVEREST MINERALS

*Formerly Mobil

Figure 3
LOCATION, STATUS AND PRINCIPAL OWNER OF MINING PROPERTIES ALONG THE SOUTH TEXAS URANIUM TREND

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STATISTICAL DATA

EXCHANGE VALUE—$25.00/lb U_3O_8
Determined as of February 28, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:
A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:
A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of February 28, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
27.20	3.1	10	5

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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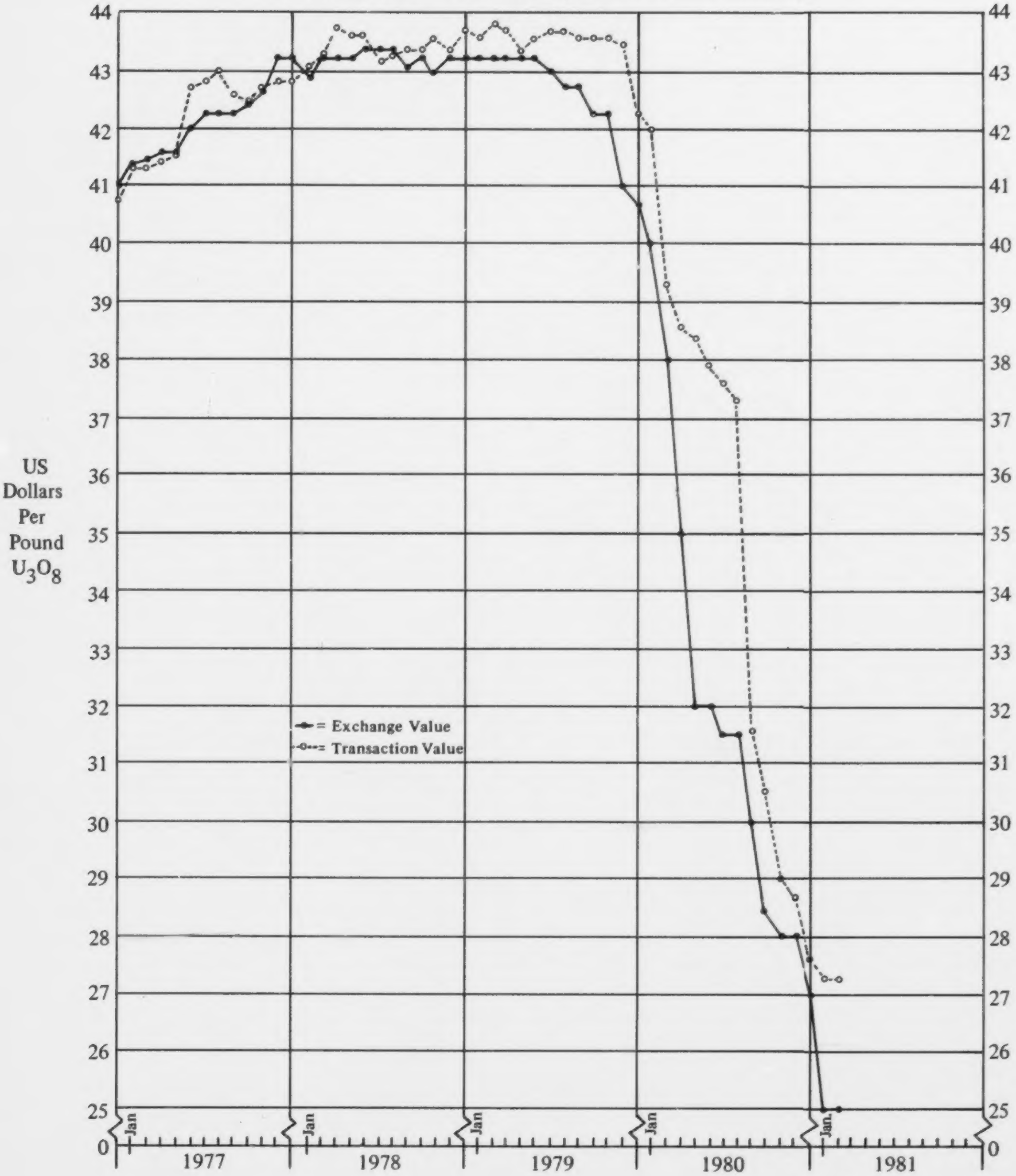
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00										

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20										

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	25.00	55.12	64.99
France (franc)	124.32	274.02	323.19
FRG (mark)	52.95	116.75	137.67
Japan (yen)	5,205	11,475	13,532
Switzerland (franc)	48.84	107.67	126.97
UK (pound)	11.20	24.69	29.11
Australia (dollar)	21.58	47.58	56.11
Canada (dollar)	30.02	66.19	78.05
Niger, Gabon (CFA)	6,216	13,704	16,160
South Africa (rand)	19.52	43.03	50.74

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

LOAN USE CHARGE RATE—7.0%/year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

CONVERSION VALUE—$1.20/lb. U as UF_6

Determined as of February 28, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and/or near term transactions for significant quantities of conversion services could be concluded as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1401	81	50 – 100	–	US	US	Price related to market
1423	81	300 – 600	–	US	US	Price related to market
Conversion Transactions						
None reported						

*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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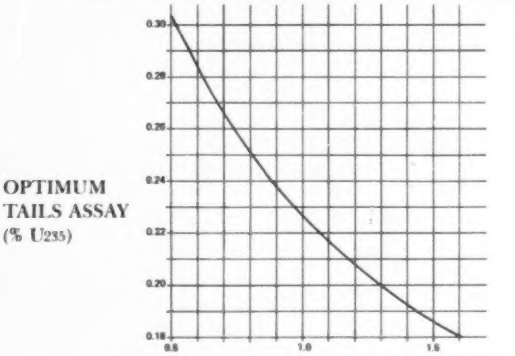
STATISTICAL DATA

OPTIMUM TAILS ASSAY

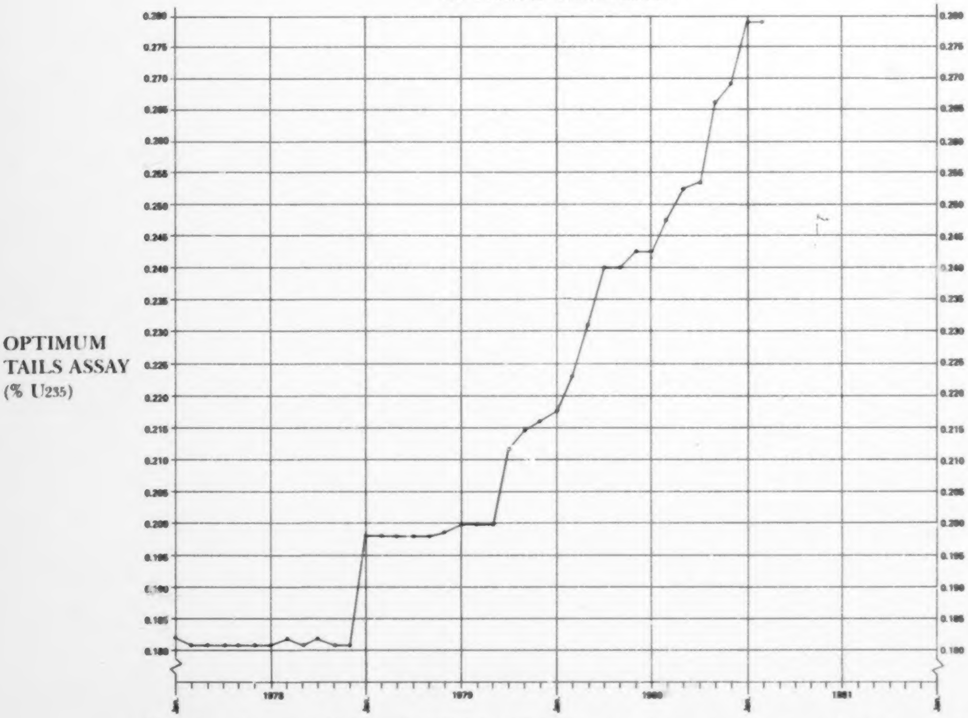
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1]Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]		
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970 (5)	110.0	116.3	91.36	3.88	3.87	3.69
Annual Avg. 1971 (5)	114.1	121.3	96.02	4.12	4.15	3.97
Annual Avg. 1972 (5)	117.9	125.3	100.00	4.56	4.59	4.26
Annual Avg. 1973 (5)	125.9	133.1	105.80	4.84	4.98	4.51
Annual Avg. 1974 (5)	153.8	147.7	116.02	5.44	5.63	4.88
Annual Avg. 1975 (5)	171.5	161.2	127.15	6.13	6.24	5.39
Annual Avg. 1976 (5)	182.4	170.5	133.71	6.76	6.87	5.91
Annual Avg. 1977 (6)	195.1	181.5	141.70	7.28	7.67	6.43
Annual Avg. 1978 (6)	209.4	195.4	152.05	8.23	8.56	7.02
Annual Avg. 1979 (6)	236.5	217.4	165.46	9.27	9.49	7.60
Nov 1979	250.6	227.5	–	9.78	9.85	7.88
Dec 1979	253.1	229.9	170.58	9.80	9.92	7.92
Jan 1980	260.6	233.2	–	9.91	10.06	7.97
Feb 1980	265.9	236.4	–	9.92	10.01	8.01
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05
Apr 1980	271.3	242.5	–	10.00	10.30	8.12
May 1980	271.9	244.9	–	10.18	10.37	8.17
Jun 1980	273.5	247.6	178.93	10.13	10.69	8.24
Jul 1980	276.2	247.8	–	10.24	10.82	8.35
Aug 1980	278.2	249.4	–	10.38	10.78	8.39
Sep 1980	278.8	251.7	182.92	10.54	10.94	8.46
Oct 1980	281.2	253.9	–	10.58	11.00	8.52
Nov 1980	282.7	256.2	–	10.73	11.06	8.59
Dec 1980	286.1	258.4	183.98	10.83P	11.29P	8.67P
Jan 1981	289.9P	260.5	–	–	–	8.67P

P = Preliminary   R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce. Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Data for 1970-1976, monthly except for the GNP Implicit Price Deflator, and Price Index data for 1977-1978 appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Employment and Earnings data for 1977-1979, monthly, appear on page 33 of Nuexco Report 147.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	215.4	190.04
Annual Avg. 1979	248.5	196.34
Sep 1979	302.4	202.24
Oct 1979	309.4	201.71
Nov 1979	310.4	201.05
Dec 1979	319.4	201.85
Jan 1980	340.1	215.72
Feb 1980	345.6	215.18
Mar 1980	340.3	214.81
Apr 1980	327.9	215.12
May 1980	335.1	214.79
Jun 1980	338.4	214.12
Jul 1980	349.1	221.41
Aug 1980	353.2	219.70
Sep 1980	351.6	219.21R
Oct 1980	348.7	220.48
Nov 1980	351.0P	220.85P
Dec 1980	–	221.18P

P = Preliminary   R = Revised since last month

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Oct 1979	227.4	9.89	7.54	7.88
Nov 1979	228.1	9.97	7.61	7.91
Dec 1979	230.4	9.93	7.51	7.89
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.3R	10.58	8.14	8.65
Sep 1980	251.9R	10.85	8.24	8.71
Oct 1980	255.6R	11.05P	8.28P	8.82P
Nov 1980	257.2	11.18P	8.34P	8.76P
Dec 1980	257.5P	–	–	–

P = Preliminary   R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)
Annual Avg. 1970 (3)	7.34	100.3 (4)
Annual Avg. 1971 (3)	7.88	106.4 (4)
Annual Avg. 1972 (3)	8.79	113.3 (4)
Annual Avg. 1973 (3)	10.51	124.1 (4)
Annual Avg. 1974 (3)	13.18	138.5 (4)
Annual Avg. 1975 (3)	16.71	157.2 (4)
Annual Avg. 1976 (3)	19.30	174.7 (4)
Annual Avg. 1977 (3)	23.87	194.4 (4)
Annual Avg. 1978 (3)	27.14	137.2
Annual Avg. 1979 (3)	30.18	155.3
Nov 1979	–	163.4
Dec 1979	31.89	164.0
Jan 1980	–	165.4
Feb 1980	–	167.0
Mar 1980	33.65	168.0
Apr 1980	–	170.0
May 1980	–	171.9
Jun 1980	34.48	174.6
Jul 1980	–	177.2
Aug 1980	–	179.2
Sep 1980	36.19	182.8
Oct 1980	–	186.3
Nov 1980	–	187.8
Dec 1980	–	189.9
Jan 1981	–	–

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(1) Chamber of Mines of South Africa, Johannesburg; "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria; "Government Gazette: Consumer Price Index for Urban Areas."
(3) Historical data for 1970 through 1979 appear on page 4.9 of Nuexco Report 140.
(4) April 1970 = 100.00

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1392	400			
1393	60	175	175	Long term
1475	1000			UF_6
1480	450			
1490	1000			
1540	1200			UF_6
1550	1550	1050		
1552	600			
1562		150	150	Long term
1575		500	500	Long term
1576	500			
1581	100	150	150	Long term
1595	600			
1600			200	Long term
1610	50			
1615	400			
1627	600			
TOTALS	8510	2025	1175	
Available for Loan:				
1429	1200			UF_6
1492	900			UF_6
1602	400			
TOTAL	2500			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1459			200	Long term
1462			100	Long term
1514	400			
1529			550	Long term
1534	250			
1587		275	275	Long term
1603	100	100	100	Long term
1640	150			
TOTALS	900	375	1225	
Inquiries to Borrow:				
1621	300			
TOTAL	300			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1451	75			
1540	650			
1584	600	200	200	
1599	800	300		
1607	850			
1609	1000			
1619		175		
1620	125			
1625		300	500	Long term
TOTALS	4100	975	700	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1492	300			
1594	400		950	Long term
1596		650		
1608	125	175	175	Long term
1614		300	500	Long term
1622	500	500	400	Long term
1625	75			
TOTALS	1400	1625	2025	

***Measured from the date of this Report.**

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 151

The **Exchange Value** remained at $25.00 per pound U_3O_8, unchanged from the previous month. Substantial amounts of uranium in the near term and longer term markets continue to be under serious discussion at this price level. In addition, many sellers have made offers of material at about this level as well.

Total of inquiries to sell in the spot and near term market continued to rise, increasing to about 8.5 million pounds U_3O_8 equivalent. Inquiries to purchase in the spot and near term market showed little change and remains just under one million pounds. Rather than acting as the impetus for buying, the lower prices are bringing more active sellers into the market. Available near term supply is now at its highest level in recent years.

The **Transaction Value** remained constant at $27.20 per pound U_3O_8. Two near term transactions closed this month involving US buyers and US sellers. A summary of pending transactions is included in the Report to indicate the large amounts of material moving in the market.

Increased activity in the long term secondary market for conversion services was seen this month. Inquiries to buy in this time frame grew substantially, while inquiries to sell focused on the spot and near term market. The **Conversion Value** stayed the same at $1.20 per pound U as UF_6.

With recent USNRC statements on licensing, the US nuclear industry continues to show a bleak post-Three Mile Island picture. These problems are discussed in this month's Report.

Also, this month's Report contains a discussion of the current status of the disputes and litigation going on in the uranium industry.

This month's *Topical Essay* discusses world uranium demand and reviews the difference between Demand and Apparent Future Consumption as defined by Nuexco. The *Raw Materials* essay continues its focus on the South Texas uranium district.

This Executive Summary may be reproduced for internal distribution. 3/81

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APRIL 1981 NUMBER 152

Monthly Report on the Uranium Market

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NUEXCO

MONTHLY REPORT ON THE URANIUM MARKET

April 1981 No. 152

JAMES E. VAUGHAN, *EDITOR*

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FOREWORD

We are happy to announce the appointment of Mr. R. Wesley Miller as Vice President, Corporate Planning and Development. Wes joined Nuexco in 1978, and for the past two and one-half years has been primarily responsible for quantitative analysis of the uranium market. In his new position, Wes will retain supervisory responsibility for that function while taking on the responsibility for Nuexco's corporate and strategic planning.

Wes Miller

Peter Stork

We are also pleased to announce the appointment of Mr. Peter Stork as our representative in Australia. Peter graduated as a Mining Engineer from the Technical University, Clausthal, Federal Republic of Germany and held various mining positions in Germany, Egypt, Africa and Central America prior to taking up permanent residence in Australia in 1961. Since that time, Peter has been closely associated with coal and uranium projects in Australia as Manager of Queensland Mines (Nabarlek) and more recently as General Manager of Marketing and Commercial Development for Pancontinental (Jabiluka). He is currently a uranium industry consultant in Australia.

Nuexco Vice President Jim Vaughan delivered a talk at the Nuexco Luncheon on the occasion of the AIF Fuel Cycle Conference in Los Angeles. A copy of his comments is included as an insert to this Report.

The Raw Materials section of last month's Report, Number 151, entitled South Texas District, Part II, contained several typographical errors. A corrected copy of the essay is included as an insert to this Report.

Beginning with this Report, Nuexco will republish the Wholesale Price Index for the Republic of South Africa in the *Statistical Data* Section.

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URANIUM MARKET

GENERAL

Uranium Disputes—Update

Last month's Report reviewed the status of uranium industry litigation. Since that time, a number of settlements and dismissals have been announced and an update of the situation follows.

Chicago Case (Westinghouse)

As a consequence of settlements and dismissals, the number of defendants in this case has been reduced to five as follows:

Australia
Queensland Mines Ltd.

US
Phelps Dodge Corp.
Englehard Minerals and Chemicals Corp.
Western Nuclear, Inc.
Anaconda Co.

Charges against Pioneer Nuclear Corp. and Federal Resources Corp. were dismissed in early March and those against Atlas Corp. were dismissed in late March. A large settlement with ten non-US companies and two US subsidiaries was announced in mid-March. This group included:

Australia
Conzinc Riotinto of Australia Ltd.
Pancontinental Mining Ltd.
Mary Kathleen Uranium Ltd.

Canada
Rio Algom Ltd.
Denison Mines Ltd.
Noranda Mines Ltd.

South Africa
Anglo-American Corp. of S.A. Ltd.
Nuclear Fuels Corp. f S.A. Ltd. (NUFCOR)

UK
Rio Tinto-Zinc Corporation Ltd.
RTZ Services Ltd.

US
Denison Mines (US) Inc.
Rio Algom Corp.

The terms of the settlement call for a cash payment to Westinghouse of $39 million and the delivery to Westinghouse of 9 million pounds U_3O_8 over the period 1981-1985 at firm prices subject to escalation. Complete details regarding which companies are providing funds and which companies are providing U_3O_8 and in what years have not been made public. Certain information is however available. Pancontinental will pay $3 million and Mary Kathleen an undisclosed sum. NUFCOR will provide part of the uranium, but no cash. Anglo will participate as a member of NUFCOR. Rio Algom Ltd. will provide some uranium (less than 50 percent of the total) but no cash.

Last month's Nuexco Report noted that Westinghouse and Kerr-McGee had reached agreement in principle on a settlement. That agreement has been effected, as have additional settlements with Utah International, Inc. and United Nuclear Corp.

Tennessee Valley Authority (TVA)—Producers

In last month's Nuexco Report a list of defendants in this case was published. In an oversight the fact that the case against Urangesellschaft GmbH had been dismissed in 1980 was omitted. During the past month, further settlements and a dismissal were announced. Thus the following four defendants remain in this case:

Canada
Gulf Minerals Canada Ltd.
Uranerz Canada Ltd.

US
Englehard Minerals and Chemicals Corp.
Gulf Oil Corp.

The case against Uranex was dismissed at the same time that TVA announced settlements with the following:

Canada
Rio Algom Ltd.
Denison Mines Ltd.
Noranda Mines Ltd.

South Africa
NUFCOR

UK
Rio Tinto-Zinc Corporation Ltd.
RTZ Services Ltd.

US
Rio Algom Corp.

The settlement provides for a cash payment to TVA of $2 million, cancellation of the 1974 Rio Algom-TVA supply contract and the dropping of two Canadian lawsuits filed by Rio Algom against TVA.

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Details of which organizations will provide the $2 million cash payment are not known.

Getty—Two Utility Groups
Two Utility Groups—12 Uranium Companies

These cases are related in that the same utility groups that are defendants in the first case are plaintiffs in the second. During March, it was announced in Judge Prentice Marshall's Chicago court that the New England utility group (Public Service Co. of New Hampshire and the other owners of the Seabrook nuclear project) had reached agreement in principle to settle with Getty, and that, should the settlement be finalized, the New England group would withdraw from the suit against the 12 Uranium Companies. Presumably this would also involve settlement of Getty's suit against the New England group and that group's counterclaim against Getty. While settlement is anticipated, it had not been finalized as of this writing.

Such a settlement would leave only the Wisconsin utility group involved in each suit.

Washington Public Power Supply System—(WPPSS)—Exxon Nuclear Corp.

WPPSS and Exxon were unable to resolve their difficulties which were reported last month. Consequently, WPPSS has filed suit against Exxon with respect to 1971 and 1973 contracts under which Exxon was to provide uranium (10-14 million pounds U_3O_8) and fuel fabrication services to WPPSS units 2 and 3.

Contention: WPPSS seeks a determination that the contracts are valid and enforceable. Exxon contends that, due to schedule delays of up to six years and major alterations in the two units, the contracts are no longer valid.

Status: Suit recently filed. Earliest possible trial date is estimated to be in 1985.

Exxon Nuclear Corp.—Alabama Power Co.

This recently filed suit involves Exxon and Alabama Power, a subsidiary of the Southern Co. At issue is a supply agreement under which certain quantities of uranium have yet to be delivered.

Contention: Exxon seeks a declaratory judgment that either it has no obligations to deliver certain quantities under the contract or that the contract terms should be reformed to adjust the price.

Status: Suit recently filed. Alabama Power has not responded as of this writing.

AUSTRALIA

There are indications that Australian producers have recently concluded sales contracts, the terms and conditions of which will probably yield higher prices than contracts recently signed by other sellers. Whether this situation will continue remains to be seen; however, the condition suggests that there may be reasons why buyers have been willing to pay higher prices to receive Australian uranium. One apparent reason is that these buyers want to encourage Australian production as another source of uranium supply, since the value to these buyers of diversified supply exceeds the incremental additional cost of the uranium. Ownership is another probable factor since some of these buyers may also be shareholders of projects in Australia and are protecting their interests against the declining price. The question remains, however, that given the current strong buyers' market, why would the buyers not hold out for the same contract terms as other sellers are offering?

There may be additional explanations. Government policies may have influenced some of the buyers to conclude these contracts. In Japan, for example, there is an apparent belief that in the long term, its raw materials will come more from Australia than Canada. The willingness of Japanese buyers to pay higher prices for uranium may therefore be part of a larger plan to obtain other raw materials under long term contract as well.

Safeguards may also be the subject of government policy influencing procurement. Some buyers view current Canadian safeguards requirements as more burdensome than those of Australia, and the lesser burden of Australian safeguards may help justify a higher price. Also, Canada has in the past interrupted uranium shipments for safeguards reasons. Some buyers view this as a more negative factor influencing security of supply than the uncertainty created by the recent safeguards debate in Australia.

On the other hand, Australian labor problems, especially concerning uranium, might be perceived by some buyers as a negative factor relative to Canada and other suppliers. A strike by the Queensland Mines Ltd. work force has very recently affected operations at Nabarlek with the staff required to run

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the plant. Additionally, dock workers and seaman's unions are blocking uranium concentrate shipments from Darwin and other Australian ports as of this writing.

A change in Australian public sentiment concerning the uranium industry is apparent in a recently released public opinion poll which showed that opposition there to the overseas sale of uranium has increased from 29 to 43 percent over the past five years. The effect on perceived security of supply of both labor problems and increased public opposition has yet to be monitored.

Meanwhile Australia signed a nuclear safeguards agreement with Sweden on March 18, 1981. Australia holds similar agreements with Finland, the Philippines, the US, the UK, France, Canada and the Republic of Korea.

The potential for long term uranium trade between Australia and Egypt was discussed in a meeting between Doug Anthony, the Deputy Prime Minister of Australia, and President Anwar Sadat last month. Egypt plans to have its first reactor finished by 1990 and has indicated interest in depending on Australia for a substantial amount of its uranium needs.

CANADA

The Key Lake Board of Inquiry's final report regarding resource development in the Key Lake area of Saskatchewan has been delivered to the Minister of the Environment. Nuexco Report 151 presented a summary of the development itself as presented by the Board. Following is an overview of the conclusions reached by the Board regarding the economics of the project and its environmental impact.

The Key Lake Mining Corp. (KLMC) plans to produce between eight and 12 million pounds of U_3O_8 per year for at least fifteen years. At least 150 million pounds of U_3O_8 will be produced during the life of the mine. The production will be divided between the partners in KLMC according to their interests. Saskatchewan Mining Development Corp. (SMDC) has a 50 percent interest in KLMC and accordingly will receive half of the product. Uranerz Canada Ltd. owns a one-third interest and Eldor Resources Ltd. owns one-sixth.

The Board acknowledged that the probable price of uranium in the future is difficult to accurately judge. Taking a figure somewhere in the middle of the ranges which were presented to them, the Board judged that the total value of Key Lake production during the period under consideration would be between six and eight billion dollars (Canadian).

According to the Board, the Province of Saskatchewan will receive revenues from this production comprised of royalties, corporate income and other taxes, and an increased cash flow to SMDC. The Board estimates that over the life of the mine, total provincial revenues are likely to be between 3.38 billion and 4.20 billion dollars. Royalties to be collected are estimated at between 1.69 and 2.00 billion dollars. Corporate income and other taxes will probably total 120 and 360 million dollars. The increment to the cash flow of SMDC will likely be between 1.56 and 1.86 billion dollars.

During the entire project life, slightly more than one billion dollars of capital and operating expenditures will be made on this project, including annual wages of about 35 million dollars during construction and 11 million to 15 million dollars during production.

Biological studies were done by KLMC to assess the plants, animals, birds and aquatic life that could be affected by the project. These studies did not predict any significant long term consequences. There are unavoidable impacts that were noted. However, the Board was satisfied that these impacts were not significant. They would be local and short term in nature and would not extend beyond the life of the project.

The Board found the measures proposed by KLMC to be adequate to protect environmental quality and to safeguard occupational health and safety. The measures would meet the requirements of Canadian and Saskatchewan law, regulations and policies. The Board expects that the recommendations contained in its report will provide a basis for the conditions under which the project may proceed.

EUROPE

The European Economic Community (EEC) Commission on Energy presented a report to its Council of Ministers advocating a nuclear energy option for member nations. Recalling the 1973 oil embargo's effect on the Western European economy, the report urged a ten percent reduction in oil consumption for electrical generation to be offset by an increase in nuclear generated electricity. The report went on to discuss the cost of nuclear generated electricity versus coal and oil fired plants and found that current high and unstable interest rates have narrowed what was previously a substantial cost differential in favor of nuclear power plants.

At the end of 1981 France will become the second ranking country in terms of nuclear installed capacity. With the scheduled operation of nine new units in 1981, France will overtake Japan and trail only the United States. The French domestic program is to bring on line one unit every two months until 1988.

FAR EAST

The first two months of 1981 saw a continuation of recent excellent operation of Japan's nuclear plants. During January and February, plant availability factors were 78.7 percent and 70.1 percent respectively while utilization rates were 72.9 percent and 69 percent.

At the same time, recognizing that the 1990 goal of 51,000-53,000 MWe nuclear installed capacity is most unlikely under current licensing procedures, responsible Japanese government agencies and utilities are examining ways to accelerate the siting, licensing and review processes that precede actual construction start-up. It is planned to reduce this siting and licensing period by more than two years by beginning safety reviews prior to the final decision to proceed with a particular unit and by reducing or eliminating review processes on the same type reactors and equipment.

As a result of a unique licensing system and shorter construction periods of four to five years, forecasts of Japanese nuclear capacity and uranium demand are more difficult to gauge than in many western countries. In the US it is most unlikely that any reactor not presently identified will be in operation by 1990. In Japan it is clear that a number of reactors will be officially ordered in the 1982-1985 period and will be on line prior to 1990. The exact number will be a function of how efficiently the Japanese can manage their siting and licensing difficulties. While the official goal remains 51,000-53,000 MWe by 1990, most people view even 45,000 MWe as an optimistic target. However, even if it became apparent that the most optimistic goal was to be approached or attained, it is unlikely that any spurt of new uranium activity would ensue since the Japanese already have a substantial surplus under contract into the 1990's.

A new uranium find in an area south of Seoul has increased Korea's uranium resources by more than 50 percent. The new find, 12.6 million tons, has an average grade about 0.04 percent, equivalent to about 10 million pounds U_3O_8. While its resources are not economically exploitable in today's market environment, Korea continues its exploration program in an effort to locate additional and higher grade material.

UNITED STATES

Uranium producers in the US continue to react to the current market situation with announcements of cutbacks and shutdowns. The heightened awareness of rising world inventory levels coupled with a 40 percent drop in the price of uranium over the past 18 months have forced US producers to adjust to the increasingly unfavorable economic outlook. Nuexco Report 147 presented a US uranium production forecast allowing for the publicly announced reductions and other information available to Nuexco at that time. Estimated US production for 1980 was revised in Report 150 to reflect the fact that the cutbacks and layoffs announced during 1980 had had little effect on 1980 concentrate production levels.

A more current Nuexco estimate of near term US production is contained in the insert to this month's Report. Revisions to the Nuexco production forecast will be made as further announcements are received. A summary of announced cutbacks and shutdowns in the US since August 1980 appears in Table 1.

Alabama Power Co.'s Farley unit 2 became the third reactor to be licensed for full power since Three Mile Island.

Attempting to find a temporary cure for the reactor licensing delays, the US Nuclear Regulatory Commission (NRC) has asked Congress for authority to issue interim licenses for nuclear plants. Under the proposed legislating fuel loading and low power testing of up to five percent would be permitted while public hearings on the plant are still in progress.

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Table 1

SUMMARY OF MAJOR US URANIUM PRODUCTION CUTBACKS ANNOUNCED SINCE AUGUST, 1980

Date	Company	Event
8/80	Kerr-McGee Corp.	Shut down two underground mines in Ambrosia Lake. Work force reduced by nine percent.
8/80	Western Nuclear, Inc.	Closed Sheep 1 underground mine near Jeffrey City, Wyoming, laid off 138 workers.
9/80	Pathfinder Mines Corp.	Laid off 40 workers at Big Eagle mine.
		Laid off 75 workers at Lucky Mc mine.
11/80	Union Carbide Corp.	Laid off 70 workers at Dove Creek, Colorado underground mine.
11/80	United Nuclear Corp.	Closed three small underground mines in the Ambrosia Lake, New Mexico district.
12/80	Rocky Mountain Energy Co.	Cut back mine and mill operations by 40 percent.
12/80	Anaconda Co.	Shut down Jackpile open pit operation, laid off about 400 workers.
1/81	Western Nuclear, Inc.	Laid off 23 workers at Split Rock Mill near Jeffrey City. Reduced production capacity by 40 percent.
1/81	Conoco, Inc.-Pioneer Nuclear Corp.	Cut back 50 percent of Conquista mine and mill operations near Falls City, Texas.
1/81	Cotter Corp.	Cut back two-thirds of mining operations near Canon City, Colorado. Only Schwartzwalder mine in Colorado and Thornburg mine near Moab, Utah now operating.
2/81	Federal American Partners	Shut down Gas Hills, Wyoming mining operations. Mill to continue to run on stockpile.
3/81	Union Carbide Corp.	Closed Uravan mill in southwest Colorado for at least six months. Curtailed mine operations at all mines in district.
3/81	Conoco, Inc.-Wyoming Mineral Corp.	Stopped development work at Crown Point mine.
3/81	Petrotomics Co.	Laid off 130 workers (approximately one third of the work force) at Shirley Basin mine in Wyoming.

TRANSACTIONS

There are four uranium transactions reported this month. One sale of between 300 thousand and 600 thousand pounds U_3O_8 occurred from a US utility to a US producer. A spot sale of between 300 thousand and 600 thousand pounds U_3O_8 took place between a US producer and a European utility. Another transaction of between 100 thousand and 300 thousand pounds U_3O_8 took place between a US utility and a European utility. Finally, a long term contract of between four million and seven million pounds U_3O_8 occurred between a European producer and a utility located in the Far East.

There are also three conversion transactions reported this month. One between a US utility and a

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European organization involved between 300 thousand and 600 thousand pounds U of conversion. One involved between 600 thousand and one million pounds U of conversion transferred between two US companies. Another sale of conversion services between two US companies involved between one million and three million pounds U of conversion.

PRICING

The **Exchange Value** as of March 31, 1981 is $25.00 per pound U_3O_8, unchanged from the two previous months. The most important factors considered in the determination of this month's Exchange Value were:

1. More than ten million pounds of concentrates are under negotiation at prices approximately equal to the current Exchange Value.

2. Since last month, Nuexco has received one more indication of a willingness to buy substantial quantities of concentrates (more than one million pounds U_3O_8) at current prices, so the market could be described as having firmed somewhat at the $25.00 level. That indication came from a producer for whom it may be advantageous to buy rather than produce.

3. Nuexco has knowledge of more producers which are considering entering the market as buyers at current price levels.

4. Some sellers are offering at prices somewhat below $25.00 in quantities which at other times would be significant. However, the quantities being offered are relatively insignificant in today's market.

Material available for sale now with delivery in the near term, as listed in the *Market Opportunities* section of this Report, totals 8.2 million pounds U_3O_8. Active inquiries in the same time frame to purchase amount to 2.1 million pounds U_3O_8. Available near term supply remains at the highest level in recent years. Approximately 15 percent of this near term material is being offered by primary producers; the balance is being offered by holders of inventory.

The **Transaction Value** declined to $27.00 per pound U_3O_8 from last month's level of $27.20. Only one qualifying transaction took place, a sale from a US producer to a European utility. Only three qualifying transactions accounting for a total of 825,000 pounds U_3O_8 have taken place in 1981. Consequently the Transaction Value is dominated by transactions from the fourth quarter of 1980, when spot prices were significantly higher than the current Exchange Value. As more transactions occur at current prices, the gap between Transaction Value and Exchange Value can be expected to narrow somewhat.

CONVERSION

Demand for conversion services continued to be active in the longer term secondary market while supply of conversion services remained at a relatively high level in the near term. As indicated in the *Market Opportunities* section of this Report inquiries to sell conversion services in the near term secondary market totaled 3.3 million pounds U as UF_6. Inquiries to purchase conversion services during the same time period amounted to 700 thousand pounds U as UF_6.

Most sales of secondary conversion services are structured as swaps: a holder of UF_6 swapping its converted material for a buyer's concentrates with the buyer paying a fee of additional concentrates or cash for the upgraded material. In both the near and longer term, however, a possible alternative is arising as holders of conversion services have expressed the desire to assign their contracts to buyers. Though potentially simpler in execution, a contract assignment would normally require approval by the primary conversion services supplier.

The **Conversion Value** remained at $1.20 per pound U as UF_6 for the third straight month. Three sales of conversion services on the secondary market are reported this month. One between a US utility and a European organization involved between 300 thousand and 600 thousand pounds U of conversion at a price somewhat above the Conversion Value. This price for conversion services was agreed upon several months ago. One transaction involved two US companies in an assignment of a conversion contract at a price close to the Conversion Value. The quantity assigned was between 600 thousand and one million pounds U of conversion. Another transaction involving two US companies was concluded for between one million and three million pounds for delivery over the next five years at a price somewhat above the Conversion Value.

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COMMENTARY

PRESIDENT REAGAN AND NUCLEAR POWER

What will President Reagan attempt?—What can he accomplish?—When?—How?

The above represents the essence of questions asked by members of the nuclear industry about President Reagan and nuclear power. The transition following the election of a new president is always marked by a sense of euphoria. Election success creates an aura of confidence. Current hopes have yet to clash with political realities. Predictions made during such transitions, therefore, must be viewed with circumspection.

President Reagan's initial priorities, as expected, have focused on domestic economics and foreign policy. A comprehensive energy policy has not yet taken form. The links between energy policy and these broader ends, namely economic and foreign affairs, have yet to be forged.

Nuclear power meanwhile is enchained by its own major problems in the financial, regulatory, judicial, legislative and public acceptance arenas. All three government branches as well as the media are involved. No centralized authority exists which can coordinate and direct the needed changes; a greater sense of shared purpose is required.

President Reagan must address several major topics including: the re-start of new nuclear power plant orders; current plant scheduling delays; the breeder program; reprocessing; waste disposal; and the problem of public leadership and the media. Each is discussed below.

Major Obstacles

A Fundamental Change: Virtually all revolutionary changes of the past two decades have been "against," not "for" progress. Tasks emerging in such an environment focused on stopping, dismantling, controlling, re-examining and risk-eliminating. Energy programs suffered more than most programs. The Reagan approach is the only broadly positive, progressive thrust involving both a change of mood and substance which has occurred in recent times. A major attempt at reversal of direction is in the offing.

The Political Problem: The subject of energy has become increasingly political. Political problems by nature defy simple, logical solutions. Thus, one would have difficulty finding politicians who do not believe that an energy problem exists, that the US should increase domestic oil production, that the US should reduce foreign dependency and use abundantly available fuels. Yet political practice often runs counter to such aims. Energy companies are attacked, nuclear power is given weak support, politicians fantasize about "soft energy," and other actions are taken having effects virtually opposite to those which all agree are desirable.

The Public Attitude Problem: Much of the force of the anti-nuclear power movement depends on a no-growth, anti-progress, anti-free enterprise, anti-capitalism movement. This is not to say that all those opposing nuclear power are a part of that movement. The recent election results have been interpreted by many as a repudiation of this "anti-philosophy" and may lead to a decline in nuclear power opposition. But, even so, enough of the anti-nuclear opposition will remain intact to constitute a formidable obstacle to constructive action.

The Organization Problem: On the governmental level, the US nuclear power program suffers from diffused responsibilities and authorities. The most critical organization, the US Nuclear Regulatory Commission (NRC), is in need of structural, procedural and personnel changes. Even after such changes are made, the NRC will suffer from committee-type operation. The reorganization task must, of course, precede implementation of policy.

The Outlook In Major Operating Areas

Plants in Operation: Despite Three Mile Island (TMI) related setbacks, US plants have continued to operate. Although nuclear power constitutes only eight percent of US generating capacity, approximately 11 percent of US electric generation is nuclear. Current average capacity factors of 60 to 65 percent are not greatly different from those achieved before the TMI accident. The plants should be the highest of priorities in order to utilize investments already in place and to pave the way for projects which follow.

Projects-in-Progress: The United States has 90 nuclear projects-in-progress ranging from contractual commitments to completed, but unlicensed, facilities. Virtually all are proceeding on schedules far longer than originally contemplated with additional delays anticipated. Some, particularly those

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less than ten percent complete, are in danger of cancellation.

Delays present two major problems, financial and functional. Consumer fuel costs are $400 to $500 million per plant per year more when oil instead of uranium is used. Assurance of electrical supply is needed, especially in industrial areas and regions of growing population.

US projects-in-progress have a value on the order of 100 billion dollars. These plants will save billions of dollars each year in fuel costs when finally in operation, in addition to reducing imported oil requirements. The investment will contribute to, rather than take from, the economy. For these and other reasons, projects-in-progress must receive high priority. Utilities obviously will not invest in new plants if unable to complete and use those already under way.

New Orders: The ability of the federal government to *cause* a resurgence of *near term* nuclear power station orders is highly limited. However, the federal government does control licensing, the result of which can make cost and schedule control open ended to the utility. Federal and state governments can prevent or halt plants' operations, with the consequences falling upon private investors. This disincentive associated with nuclear power versus other energy sources is a mounting problem.

Until investigators and management are protected from precipitate government action, new commitments for nuclear plants will not be made. Such protection requires Congressional legislation and Congress is unlikely to act without prodding by the Executive Branch and rising public concern. A realistic hope is that a workable solution will be in place before the end of President Reagan's present term of office. Prospects for orders in the mid-1980's depend upon initiatives in the next year or two.

The Fast Breeder: Although the fast breeder is encountering resistance from those controlling the administration's budget, Clinch River will likely proceed. That project can be accelerated by government funding. The project has major symbolic significance since support for Clinch River is viewed as support for nuclear power.

Reprocessing: Reprocessing is not an urgent matter except as a contribution to the "waste disposal solution." The cost of reprocessing is not large enough to be prohibitive and may proceed for non-economic reasons. Whatever the decision, the viability of the light water reactor is not likely to be impacted by the reprocessing issue.

Waste Disposal: A solution to the waste disposal problem as viewed by the *public* is essential. Waste disposal is an effective anti-nuclear tool and will remain to plague nuclear power. Nonetheless, the waste disposal program must proceed in *parallel* with the light water reactor program. There is insufficient time for them to proceed in *series*.

Conclusions

1. President Reagan is well equipped to add vigor to the US nuclear power program. He has the will, the communications ability and the staff support to do so. A revitalization of nuclear power by the mid-1980's will require a strong helmsman and patient public support. The main challenges are tests of will, skill and philosophical wisdom.

2. Nuclear power has reached a watershed. Past concepts governing licensing, financing, ownership, engineering, and other basic considerations may not be suitable for the challenges of the future. Merely repairing the present structure will not be sufficient to revitalize nuclear power. Accordingly, problems facing the Reagan Administration are more than administrative. A whole new future framework for the industry may be required.

The most productive areas for short term concentration are those in which the ownership financing operating etc., die is already cast, namely projects-in-progress. Immediate progress can be made with improvements in the licensing process.

3. Operating plants may be less hampered by licensing issues, but one cannot expect an increase in capacity factor of more than five percent. From the standpoint of the uranium industry, this translates to a *potential* increase in consumption of only about one to two million pounds U_3O_8 annually.

Projects-in-progress are expected to advance more effectively. If the NRC reaches its goal of issuing six operating licenses per year, consumption would accelerate by two to 2.5 million pounds per year. However, utilities have already experienced major start-up delays, while uranium deliveries continue based on original contract schedules. The impact on the market of six new operating licenses per year will be modest for some time. New plant orders before the

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COMMENTARY

mid-1980's are unlikely and cannot, under the best of circumstances, create actual demand during this decade.

4. The uranium industry should, therefore, avoid overexpectations. The positive attitudes of the Reagan Administration are widely welcomed. Conditions will improve, but only at a rate lower than that which can solve the overproduction problems facing US producers.

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RAW MATERIALS

URANIUM RESOURCE EVALUATION

Introduction

The surge in uranium exploration activity during the period extending from 1968 through 1979 was precipitated by a series of events including: the surge of nuclear reactor sales in 1965-1968; utility industry projections for a seven percent annual increase in power demand; the 1973-1974 oil embargo; and industry projections that a uranium supply shortfall would occur in the late 1970's. As these events affected the industry, the economic potential for controlling uranium resources served to induce numerous mining organizations, electric utility companies and governmental agencies to initiate uranium exploration programs. The result of the widespread exploration activity was a large increase in world uranium resources. In November 1980 Nuexco estimated reasonably assured resources (RAR) at 2,800,000 tonnes U_3O_8, an increase from the 635,000 tonnes U_3O_8 world RAR as of the end of 1967 estimated by the International Atomic Energy Agency (IAEA) and the Organization for Economic Cooperation and Development (OECD).

Resource Classification

The Nuexco classification of RAR is consistent with the terminology applied to *uranium resources* by the IAEA and is equivalent to *ore reserves* as reported by the US Department of Energy (USDOE). The resource estimates of the IAEA, USDOE and Nuexco are defined as known quantities of uranium which can be recovered within a given cost range based upon current mining and milling technology. The cost cutoff used in each case is compatible with uranium market conditions at the time the evaluation was made. The 1967 cutoff was based on a forward production cost of US$10 or less per pound U_3O_8 (IAEA estimate). The November 1980 estimate by Nuexco was based on a forward production cost of US$50 or less per pound U_3O_8.

Forward cost is defined by the IAEA and USDOE to include all capital and operating expenditures incurred after the date of the ore reserve estimate for building, maintaining and operating new and existing uranium facilities. Sunk costs, interest, return on investment and income taxes are not included. Obviously, economic viability of an ore deposit is dependent upon a U_3O_8 selling price that is substantially higher than projected forward costs. Nuexco estimates that a ratio of selling price to forward cost of approximately 1.5 to 2.0 is necessary to yield a 15 to 20 percent after tax return on investment.

The classification of uranium resources into forward production cost categories was established in 1961. The US Atomic Energy Commission (USAEC) maintained a forward cutoff cost level of $8 per pound through 1970. The USAEC revised the forward cost criteria for US RAR into categories of $6, $8, $10 and $15 per pound U_3O_8. The IAEA introduced and maintained forward cost categories of US$10 and $15 from 1965 through 1972.

Uranium prices and production costs increased rapidly from 1974 to 1976, resulting in the need to reclassify exploitable RAR into higher cost categories. By the end of 1979, USDOE had established cost categories of $15, $30, $50 and $100 per pound U_3O_8 for the US. The IAEA introduced cost categories of US$30 and $50 per pound U_3O_8. The impact of these production cost increases on RAR was the transfer of low grade reserves into higher cost categories thereby reducing the average ore grade of RAR, and increasing overall RAR. The upper cost cutoff represents the cost at which computed RAR assigned to all categories could be recovered.

Present Resource Status

The commercial market for uranium has been seriously affected by steady inflation since 1973 and more recently by an oversupply of uranium concentrate which has depressed spot prices. Thus the current classification of RAR in the $50 category may now be misleading. The purpose of this essay is to attempt to revise the forward cost cutoff downward to conform with the existing commercial level of property development and market activity.

The present spot market of US$25 per pound for U_3O_8 is probably a more appropriate cost cutoff to assess RAR today. Table 2 represents Nuexco's estimate of RAR at a forward cost cutoff of US$25 per pound of U_3O_8. For comparison, Table 2 also tabulates Nuexco's November 1980 RAR estimate of US$50 or less per pound. The $25 forward cost category yields estimated RAR of 1,729,000 tonnes U_3O_8 compared to the $50 estimate of 2,800,000 tonnes. The breakdown of adjustments in RAR by region follows.

Table 2

SUMMARY OF WORLD URANIUM RESOURCES REASONABLY ASSURED AT US$25 OR LESS PER POUND U_3O_8—COMPARED TO $50 OR LESS PER POUND

	Resource Classification—Tonnes U_3O_8	
Country	$50.00 Resources (Nov. 1980)	$25.00 Resources (March 1981)
Africa:		
South Africa	152,000	112,000
Namibia	104,000	90,000
Niger	195,000	72,000
Algeria	33,000	-0-
Gabon	24,000	24,000
Israel	36,000	-0-
Central African Republic	9,500	-0-
Egypt	5,000	-0-
Asia:		
Japan	8,200	-0-
India	30,000	-0-
Australia	165,200	395,000
Europe:		
France	95,600	19,000
Spain	12,500	-0-
Portugal	9,000	-0-
Sweden	1,200	-0-
Greenland (Denmark)	32,000	-0-
Italy	1,200	-0-
Greece	1,000	-0-
Yugoslavia	8,000	-0-
North America:		
Canada	279,000	232,000
United States	850,000	485,000
Mexico	7,600	-0-
South America:		
Argentina	28,000	-0-
Brazil	115,000	-0-
Totals	2,800,000	1,729,000

Africa: RAR in South Africa are related to gold recovery in the Witwatersrand district, to copper recovery at Palabora and to primary uranium deposits in the Karoo sediments. Only the resources assigned to the Karoo sediments have been eliminated in the $25 category. In Namibia, RAR in the $25 category are limited to the Rossing deposit. All undeveloped reserves in Niger were eliminated in the new category; only the Arlit and Akouta RAR remain. All RAR in Gabon are associated with the Oklo and Mounana

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production centers and are therefore included. Resources in Algeria, Israel, Central Africa Republic and Egypt are excluded.

Australia: The large high-grade deposits located in the Northern Territory: Jabiluka, Ranger and Koongarra; the Yeelirrie deposit in Western Australia and the remaining reserves at the Mary Kathleen mine in Queensland represent RAR of 101,000 tonnes U_3O_8 available at a $25 per pound forward cost cutoff. The remaining deposits in the country are excluded. Roxby Downs in South Australia has the potential to be a large uranium resource as a co-product with copper production, however, the deposit is still in the exploration stage and total uranium resources are uncertain and are thus not included in the $25 category.

Europe: It is estimated that less than 20,000 tonnes of RAR in France will remain in the lower forward cost category of $25, due to the generally low-grade nature of the ore deposits. RAR in Spain, Portugal, Sweden, Greenland, Italy, Greece and Yugoslavia are not included in the $25 category because the deposits in those countries are generally of low grade. Isolated high-grade ore does exist but not on a scale large enough to support low-cost production.

North America: RAR in Canada are limited to the high-grade deposits located in northern Saskatchewan and the high volume operating mines at Elliot Lake. The undeveloped deposits scattered throughout the rest of Canada are all of higher forward cost than $25.

Reassessment of resources in the United States is difficult and complicated because of the large number of deposits and the wide distribution of ore grades.

Total RAR for the US in the $25 forward cost category is estimated at 185,000 tonnes U_3O_8, down about 365,000 tonnes from the 1980 estimate by Nuexco done at a $50 cutoff.

Other Considerations

World RAR will likely continue to be downgraded as a result of rising operating costs. Since exploration activity is also decreasing, newly discovered reserves may not offset deletions from lower cost categories. This is especially true in the US where low grade deposits have high production costs, and 1980 exploration activities were below the 1979 level by 34 percent. The situation is less severe in Australia and Canada because exploration in both countries continues almost unabated and new discoveries continue to add to resources.

Although all or part of the RAR of many nations are eliminated at the $25 cutoff, it is still likely that some of those reserves will continue to be exploited for other reasons. For example, several nations have a national interest in producing uranium from domestic resources.

A breadown of RAR distribution at the $25 cutoff shows 28 percent available in the US, 23 percent in Australia, 13 percent in Canada, 24 percent for South Africa and 12 percent for the remaining Free World. The distribution of RAR in today's market environment clearly illustrates that the US, presently with over 40 percent of the commercial uranium demand will very likely become more dependent on imported supplies.

STATISTICAL DATA

EXCHANGE VALUE—$25.00 lb U_3O_8
Determined as of March 31, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.

B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of March 31, 1981

$ lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
27.00	3.3	11	6

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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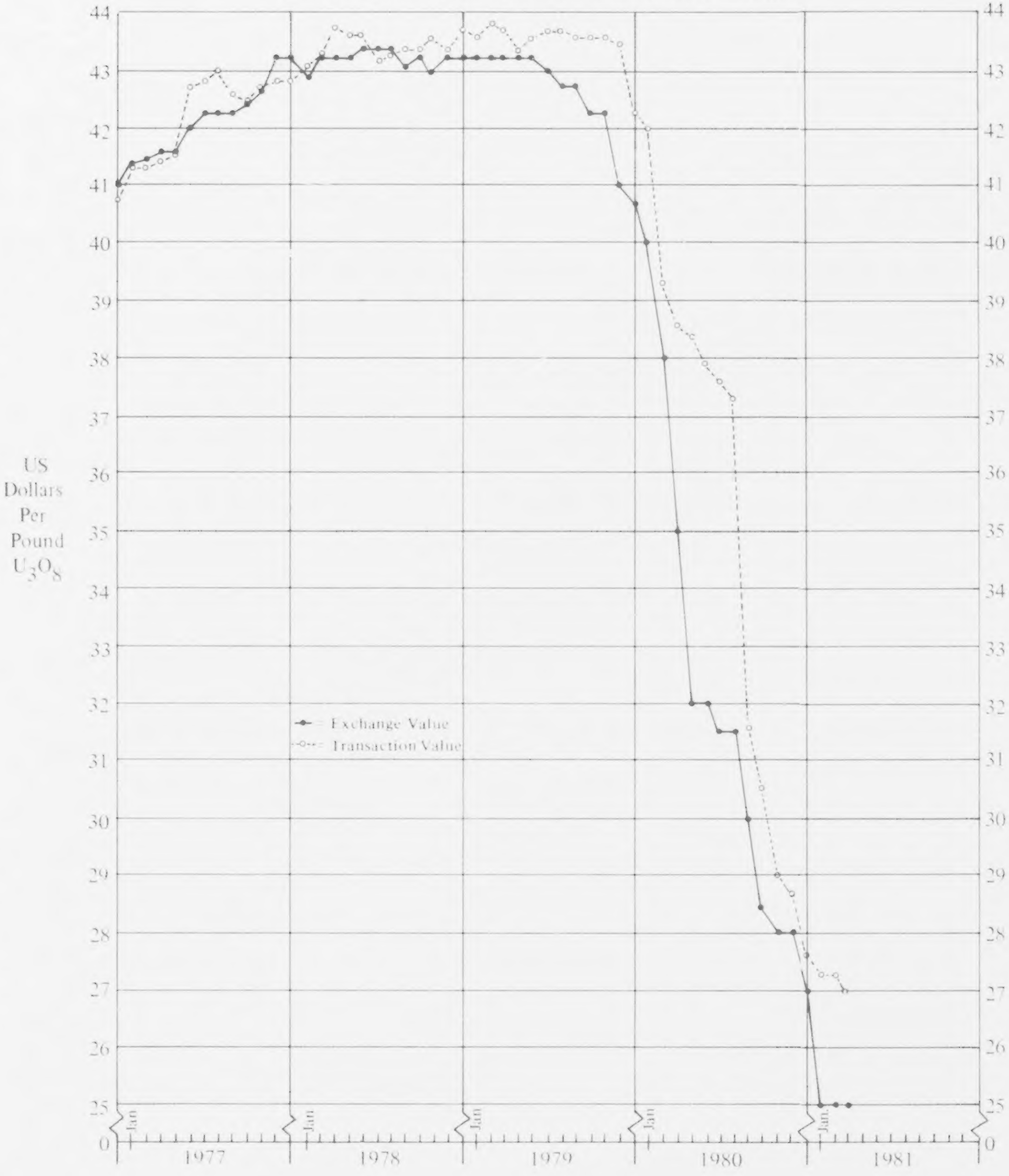
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968								6.35	6.35	6.40	6.45	6.50
1969		6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00									

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976					39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00									

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	25.00	55.11	64.99
France (franc)	122.24	269.51	317.82
FRG (mark)	51.91	114.44	134.95
Japan (yen)	5,272	11,623	13,706
Switzerland (franc)	47.36	104.42	123.14
UK (pound)	11.14	24.57	28.97
Australia (dollar)	21.48	47.35	55.84
Canada (dollar)	29.72	65.53	77.28
Niger, Gabon (CFA)	6,112	13,476	15,891
South Africa (rand)	19.96	44.02	51.91

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

LOAN USE CHARGE RATE—7.0%/year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

CONVERSION VALUE—$1.20/lb. U as UF6

Determined as of March 31, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and/or near term transactions for significant quantities of conversion services could be concluded as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

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CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1425	81	301 – 600	–	US	US	Price related to market
1427	81	301 – 600	102	US	Europe	
1448	81	101 – 300	–	US	Europe	Definitive price information unknown
1455	85 – 94	4001 – 7001	–	Europe	Far East	
Conversion Transactions						
1399	81 and 83	601 – 1000	100	US	US	
1423A	81	301 – 600	135	US	Europe	
1469	81 – 85	1001 – 3000	125	US	US	

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*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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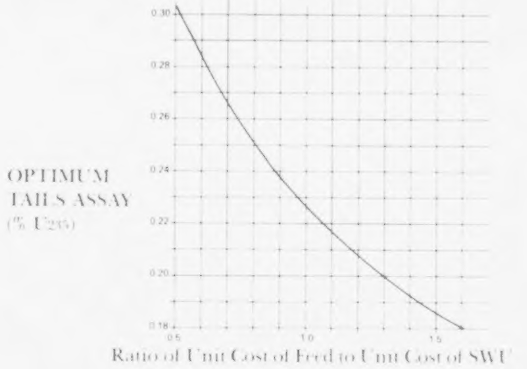
STATISTICAL DATA

OPTIMUM TAILS ASSAY

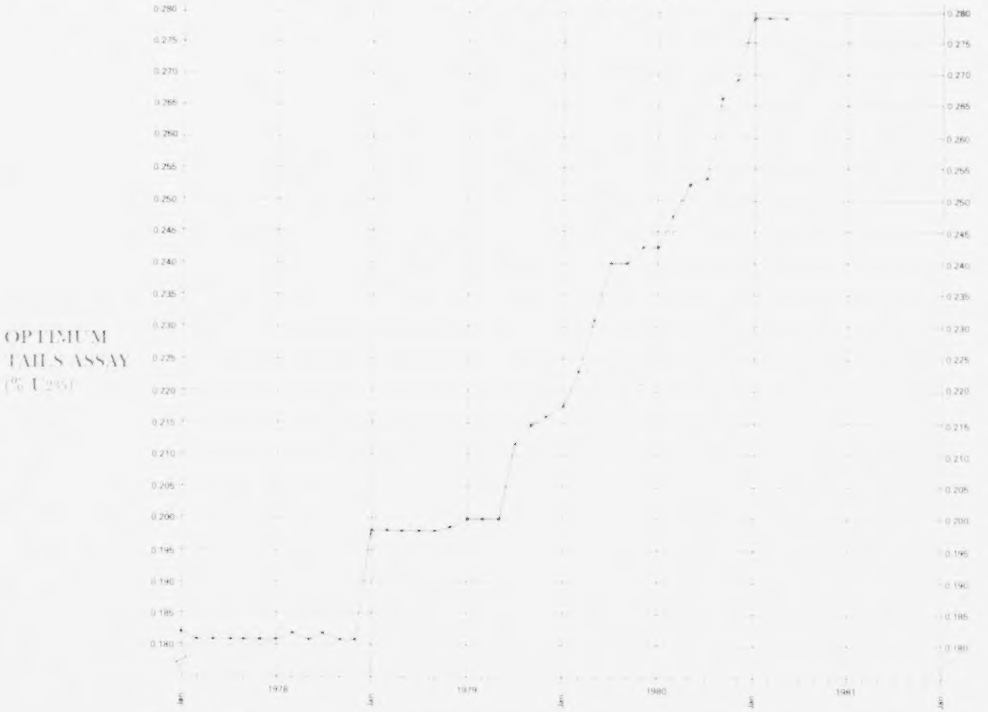
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]		
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970 (5)	110.0	116.3	91.36	3.88	3.87	3.69
Annual Avg. 1971 (5)	114.1	121.3	96.02	4.12	4.15	3.97
Annual Avg. 1972 (5)	117.9	125.3	100.00	4.56	4.59	4.26
Annual Avg. 1973 (5)	125.9	133.1	105.80	4.84	4.98	4.51
Annual Avg. 1974 (5)	153.8	147.7	116.02	5.44	5.63	4.88
Annual Avg. 1975 (5)	171.5	161.2	127.15	6.13	6.24	5.39
Annual Avg. 1976 (5)	182.4	170.5	133.71	6.76	6.87	5.91
Annual Avg. 1977 (6)	195.1	181.5	141.70	7.28	7.67	6.43
Annual Avg. 1978 (6)	209.4	195.4	152.05	8.23	8.56	7.02
Annual Avg. 1979 (6)	236.5	217.4	165.46	9.27	9.49	7.60
Dec 1979	253.1	229.9	170.58	9.80	9.92	7.92
Jan 1980	260.6	233.2	—	9.91	10.06	7.97
Feb 1980	265.9	236.4	—	9.92	10.01	8.01
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05
Apr 1980	271.3	242.5	—	10.00	10.30	8.12
May 1980	271.9	244.9	—	10.18	10.37	8.17
Jun 1980	273.5	247.6	178.93	10.13	10.69	8.24
Jul 1980	276.2	247.8	—	10.24	10.82	8.35
Aug 1980	278.2	249.4	—	10.38	10.78	8.39
Sep 1980	278.8	251.7	182.92	10.54	10.94	8.46
Oct 1980	281.2	253.9	—	10.58	11.00	8.52
Nov 1980	282.7P	254.2R	—	10.73	11.06	8.59
Dec 1980	286.1P	258.4	183.98	10.86	11.31	8.68
Jan 1981	289.9P	260.5	—	10.93P	11.42P	8.71P
Feb 1981	294.8P	263.2	—	—	—	—

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Data for 1970-1976, monthly except for the GNP Implicit Price Deflator, and Price Index data for 1977-1978 appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Employment and Earnings data for 1977-1979, monthly, appear on page 33 of Nuexco Report 147.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	**Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)**[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	215.4	190.04
Annual Avg. 1979	248.5	196.34
Sep 1979	302.4	202.24
Oct 1979	309.4	201.71
Nov 1979	310.4	201.05
Dec 1979	319.4	201.85
Jan 1980	340.1	215.72
Feb 1980	345.6	215.18
Mar 1980	340.3	214.81
Apr 1980	327.9	215.12
May 1980	335.1	214.79
Jun 1980	338.4	214.12
Jul 1980	349.1	221.41
Aug 1980	353.2	219.70
Sep 1980	351.6	219.21R
Oct 1980	349.5R	220.48
Nov 1980	351.7R	220.85P
Dec 1980	353.0P	221.18P
Jan 1981	359.1P	–

P = Preliminary   R = Revised since last month

(1) Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra: "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 1.7 and 1.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Oct 1979	227.4	9.89	7.54	7.88
Nov 1979	228.1	9.97	7.61	7.91
Dec 1979	230.4	9.93	7.51	7.89
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.3	10.58	8.14	8.65
Sep 1980	252.0R	10.85	8.24	8.71
Oct 1980	255.8R	11.05	8.28	8.82
Nov 1980	257.5R	11.11R	8.38R	8.77R
Dec 1980	257.8R	11.07P	8.35P	9.01P
Jan 1981	261.1P			

P = Preliminary   R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa, "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 1.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 1.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)
Annual Avg. 1970 (3)	7.34	100.3 (4)	
Annual Avg. 1971 (3)	7.88	106.4 (4)	59.1
Annual Avg. 1972 (3)	8.79	113.3 (4)	63.9
Annual Avg. 1973 (3)	10.51	124.1 (4)	72.3
Annual Avg. 1974 (3)	13.18	138.5 (4)	85.3
Annual Avg. 1975 (3)	16.71	157.2 (4)	100.0
Annual Avg. 1976 (3)	19.30	174.7 (4)	115.1
Annual Avg. 1977 (3)	23.87	194.4 (4)	130.0
Annual Avg. 1978 (3)	27.14	137.2	142.7
Annual Avg. 1979 (3)	30.18	155.3	164.5
Annual Avg. 1980	35.53	176.7	192.1
Dec 1979	31.89	164.0	176.8
Jan 1980		165.4	178.3
Feb 1980		167.0	180.5
Mar 1980	33.65	168.0	181.7
Apr 1980		170.0	184.2
May 1980		171.9	187.0
Jun 1980	34.48	174.6	189.0
Jul 1980		177.2	192.7
Aug 1980		179.2	196.8
Sep 1980	36.19	182.8	199.8
Oct 1980		186.3	203.1
Nov 1980	—	187.8	205.6
Dec 1980		189.9	206.5
Jan 1981		191.0	207.2
Feb 1981	—	193.8	—

(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette" Consumer Price Index for Urban Areas.
(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 19 of Nuexco Report 140.
(4) April 1970 = 100.00

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
Available for Sale:				
1392	400			
1393	60	175	175	Long term
1475	1000			UF_6
1480	300			
1490	1250			
1540	700			UF_6
1550	1550	1050		
1552	600			
1562		150	150	Long term
1564	20			
1575		500	500	Long term
1576	250			
1581	100	150	150	Long term
1595	600			
1600			200	Long term
1610	50			
1615	400			
1627	1000			UF_6
TOTALS	8280	2025	1175	
Available for Loan:				
1429	700			UF_6
1492	900			UF_6
1602	400			
TOTALS	2000			

*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1423	1000	1000		
1459			200	Long term
1462			100	Long term
1514	400			
1529			550	Long term
1587		275	275	Long term
1603	100	100	100	Long term
1634		400	400	
1636	465	850	900	
1640	150			
TOTALS	2115	2625	2525	
Inquiries to Borrow:				
1621	300			
TOTAL	300			

---

*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1451	75			
1540	900			
1584	200	200	200	
1599	150	300		
1607	850	900	1000	
1609	1000			
1619		175		
1620	125			
1625		300	500	Long term
TOTALS	3300	1875	1700	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1594		400	950	Long term
1608	125	175	175	Long term
1614		300	500	Long term
1622	500	500	400	Long term
1626	75			
TOTALS	700	1375	2025	

*Measured from the date of this Report.

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 152

The **Exchange Value** remained at $25.00 per pound U_3O_8 for the third consecutive month. Potential buyers continue to express a willingness to buy substantial amounts of concentrates at current prices. Additionally, a large quantity of material is presently under negotiation at about this level.

Total of inquiries to sell in the spot and near term market remained high at approximately 8.2 million pounds U_3O_8. Active inquiries to purchase in the spot and near term market increased to 2.1 million pounds U_3O_8. Much of this interest is indicated by producers who are considering entering the market as buyers.

The **Transaction Value** declined to $27.00 per pound U_3O_8 from last month's level of $27.20. Four uranium transactions are reported this month. Three of the four are spot transactions involving approximately 800,000 pounds U_3O_8 equivalent. In addition, a long term contract of between four million and seven million pounds U_3O_8 was signed between a European producer and a Far East utility.

Three sales of conversion services in the secondary market are reported this month. The **Conversion Value** remained unchanged at $1.20 per pound U as UF_6. The longer term secondary market for conversion services continued to be dominated by inquiries to buy while the near term supply remained at a relatively high level.

US uranium producers have responded to the unfavorable market situation with announcements of cutbacks and shutdowns. This month's Report summarizes the shutdowns and work force reductions over the past eight months.

Also, this month's Report contains an update on the status of disputes and litigation in the uranium industry as reported last month.

This month's *Commentary* takes a look at President Reagan's potential relationship with the nuclear industry along with the nuclear power obstacles he faces. A revised assessment of reasonably assured resources (RAR) is presented and discussed in the *Raw Materials* essay.

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COMMENTS OF:

James E. Vaughan
Vice President
Nuexco

PRESENTED AT:

Nuexco Luncheon
AIF Fuel Cycle Conference
March 16, 1981
Los Angeles, California

NUEXCO

Comments of:

James E. Vaughan
Vice President
Nuexco

About a year ago, at this same AIF luncheon, I spoke before this group and offered several predictions about the behavior of the 1980 US uranium market. I would like to begin today by looking back at last year's talk.

On the consumption side, I forecast that 28.5 million pounds of U_3O_8 would be used in the US in 1980. This included 11 million pounds for US reactors which were then designated as being under construction. The prediction included 14 reactors which were "nearly ready," although we commented that probably no more than six or eight would actually receive operating licenses during 1980. In fact, only four new licenses were issued last year in the US. The Tennessee Valley Authority received a conditional full power license for its Sequoyah unit 1. Full power licenses were issued to Virginia Electric & Power Co. for North Anna unit 2 and Public Service Electric & Gas Co. for Salem unit 2. Alabama Power Co.'s Farley unit 2 was granted a low power license in early September. The effect of this licensing slowdown can be seen in the reduced US consumption level. Consumption, as defined by Nuexco, was acutally only about 18 million pounds U_3O_8 in 1980, much less than we had forecast.

On the production side, last year I said that US production would decline from the 1979 level of 37.5 million pounds U_3O_8 by as much as ten percent. In fact, US production increased to approximately 42.5 million pounds. The overall US production consumption ratio in 1980 was 2.5. The extent of the actual market disequilibrium in 1980-1981 led to downward price pressure considerably more severe than anticipated.

The worldwide (non-Communist) picture was even worse. In 1980, world production was 110 million pounds U_3O_8 and consumption, as defined by Nuexco, was only 40 million pounds, a ratio of 2.75. Looking at these numbers, it is not surprising that the uranium price continued to fall from $35 per pound U_3O_8 (the Exchange Value at the time of last year's AIF Fuel Cycle Conference) to the current level of $25.

What caused the low level of US consumption? As I mentioned earlier, the post-Three Mile Island (TMI) licensing logjam was much greater than anticipated. Over the past two years, the number of new US nuclear power plants estimated to begin commercial operation has changed drastically. Before TMI, Nuexco estimated that 61 plants would begin commercial operation in the US during the period 1979 through 1984. Six months after TMI, the number had dropped to 50. Last November Nuexco estimated that 21 plants would start up during that time period. Today, in light of recent US NRC statements, we foresee only 17 in that category.

Given reduced consumption and falling prices, why did US production increase in 1980? One word just about sums it up. Momentum. We inaccurately estimated the short-run time lags between producers' apprehension of a deteriorating market and subsequent decisions to cut back or not to produce. Moreover, the time between such decisions and actual implementation was longer than expected.

In open pit mining, the time lag between laying-off of workers involved in stripping of overburden and running out of ore to mine is between three and nine months. The existence of ore stockpiles and a higher average ore grade (0.12 percent U_3O_8, versus 0.11 in 1979) also helped maintain production momentum. Decisions to shut down could not be made quickly and involved many factors including decommissioning and tailings cleanup cost considerations.

What is the outlook for the US in 1981? Nuexco predicts consumption in the US will be 21 million pounds U_3O_8, a small increase from the 1980 level. We anticipate US production will be about 37 million pounds in 1981. Estimated US producer contractual commitments for 1981 total 42 million pounds, a five million pound difference. Nuexco predicts at least a 30 percent drop in production in 1980 through 1982, and continuing decreases thereafter. For 1982, Nuexco anticipates US production will be at most 30 million pounds U_3O_8 to cover an estimated 37 million pounds of US producer commitments. For 1983 the current Nuexco estimates are 26 million pounds of production to cover 32 million pounds of commitments. Thus from 1981 through 1983, there may be as much as 18 million pounds of US producer commitments which cannot be met by US production presently expected. This shortfall will have to be met by a combination of purchases, rescheduling and renegotiation.

Why this expected decline in the US industry? US producers generally cannot survive at a $25 per pound price. The median US incremental production cost is about $24, not including sunk costs. Therefore about half of all US producers could not economically justify selling at today's prices, even on a marginal basis.

On the other hand, new production from Australia and production from Canada's Rabbit, Cluff and Key Lakes is expected to run at a *total* cost considerably lower than today's market price. Thus we have a US industry potentially in contraction and a non-US industry in expansion. Let's examine the industry outlook more specifically:

South Africa: When gold was above $600 an ounce, South African producers announced that they would stockpile uranium rather than sell into the weakened spot market. The price of gold has slipped to about $500. If the price of gold doesn't recover, you might look for some quiet spot selling by the South Africans.

Central Africa and France: Cogema announced some production cutbacks in France during the past year. But for political reasons expect France, Niger and Gabon to continue at close to current output.

Australia: Both Queensland Mines and Ranger are already close to being sold out. The Australia situation brings up an interesting question. Why did Japan and Germany (and other European countries) buy from Ranger? There was no apparent near term need. One answer is that the purchases were seen by the buyers as an "insurance policy" for the late 80's and 90's, and assured continued competition with Canada and South Africa.

Yeelirrie is largely committed to equity owners. As for Koongarra, if Denison goes forward with the project, one could argue that it would be to use the output to displace some Elliot Lake production. Jabiluka is the only remaining major uranium deposit which is unsold. It will probably be developed only if economic commitments can be made for the late 1980's. The by-product output of Roxby Downs will probably come about later in time.

Canada: In my mind, Canada's Key Lake is the most exciting thing happening at this time. Key Lake has an ore grade of 2.5 percent U_3O_8 in more than 150 million pounds of reserves. Production is expected to be at the rate of up to 12 million pounds annually. The Key Lake Board of Inquiry has just published its findings and all looks well to continue the development of the property.

The question to ask then is whether the Europeans and the Japanese will decide to buy this additional insurance from Key Lake and will they decide to do the same with Jabiluka?

US: In the US the situation is one of Adam Smith's *Invisible Hand* of free market competition, versus the *Visible Hand* of external forces. Why won't US utilities buy an "insurance policy" of US production? There is no mechanism for US utilities to act as a group, as there is in Japan for example. If US utilities act individually, it would probably be more of a market related action than a politically related action. Even if the utilities could act as a group, there are 51 separate Public Utility Commissions that must be willing to approve the action, also as a group. This is unlikely, barring federal preemption of electric ratemaking, or other federal action.

Is such an insurance policy necessary in the US? Perhaps not, due to the large uranium inventories of both US utilities and the US government. Also, the presence of tremendous US uranium reserves can be seen as an argument against the need for an insurance policy, however high the production cost of US uranium. The US inventories would provide the time cushion to get these US reserves into production if they were needed in the event of interruption of other sources.

Another *Visible Hand* approach would be an embargo on foreign uranium imports to aid US producers. However, this does not appear likely for several reasons:

1. Foreign competition does not appear to be a factor in the current decline of the fortunes of the US industry. The problem is insufficient consumption.

2. There is not much visible political support for an embargo. Utility and oil companies are generally not on record as being in favor.

3. Any hindrance to a free market would run counter to President Reagan's political and economic beliefs.

Finally, what is the price outlook for the near future? We have seen that the lower price of uranium has not yet removed many spot sellers from the market. In fact the total spot supply is greater now than last year. Any dramatic change in price level would probably need a dramatic event to trigger it, as TMI did in the downward direction.

RAW MATERIALS

SOUTH TEXAS DISTRICT—PART II

Host-Rock Geology

The Tertiary formations of South Texas were deposited in a coastal marine and continental environment. The uranium-bearing formations consist of thick tuffaceous and clay units (the Fant Tuff and Frio Clay); sandstone units (Oakville, Tordilla, Deweesville and Dillworth); and fine to coarse-grained sandstone and conglomeratic units (Goliad and Soledad). The entire sequence is characterized by oscillating depositional patterns marked by facies changes which commonly include any combination of formational deposit. Carbonaceous material and lignite may occur in light to heavy concentrations throughout the more sandy units. The predominant depositional patterns of the Eocene formations are related to beach and barrier-bar structures; the younger formations are associated with continental deposition consisting of fine to coarse sand and conglomeratic units. The source of the fine to coarse sand and conglomeratic material may have originated in West Texas and northern Mexico; the tuffs were deposited during regional volcanic activity.

Uranium mineralization is commonly found in sand and sand mud facies filling erosional channels, and in well defined beach and barrier-bar structures. The most important ore deposits are associated with depositional changes in fluvial channel environments. A greater concentration of uranium often occurs where lignite and carbonaceous material are abundantly dispersed throughout sand units, especially where permeability is relatively high. There is also an apparent relationship between the concentrations of uranium and clay minerals present in certain sand clay host units. The clay particles acted to restrict the normal flow of mineral bearing solutions and consequently afforded the rapid precipitation of uranium, enriching the clay-bearing unit. It was concluded that the uranium deposits of the district were formed by epigenetic process—placement of the uranium occurred after and totally independent of the deposition of the host formation.

The unoxidized uranium deposits of the district are significantly larger than were the oxidized deposits mined in the 1960's. Unoxidized mineralization has notably formed in anomalous concentrations along sinuous alteration fronts, or roll fronts, similar to deposits in the Tertiary rocks of Wyoming. Low-grade uranium may occur continuously for several miles along a front; however, the higher grade uranium usually occurs as discrete accumulations randomly distributed along the roll front. Molybdenum, selenium and arsenic occur as accessory minerals to the uranium in certain areas throughout the district. The accessory minerals can be useful as an exploration guide under cetain circumstances. Organic material, pyrite and clay minerals are common constituents associated with uranium.

The principal source of uranium mineralization is considered to be the thick volcanic ash (tuff) sequence of Miocene Age that covered the entire region. As the tuff formation eroded, primaraily toward the gulf, the contained uranium was leached from the tuff to be absorbed and transported downdip by oxygenated ground water. Precipitation of the uranium in a favorable host rock occurred in a reducing environment. The reducing environment was probably created by the upward migration of hydrogen sulfide and or methane gas associated with deeper deposits of oil and gas. Formation permeability and faulting are the main factors controlling the migration of the reductants to the surface; thus offering a guide to exploration.

The ore minerals common to the district are both oxidized and unoxidized. The first mining was from shallow open pit mines (average depth about 40 feet) situated along a trend from Deweesville, through Tordilla Hill, and into Live Oak County. About 200,000 tons of ore averaging 0.20 percent U_3O_8 were mined between 1960 and 1964, nearly all of which was oxidized. The principle uranium minerals were autunite—a calcium phosphate of uranium, and tyuyamunite—a calcium, uranium vandate. Carnotite—a uranium vandate, was present in minor amounts. Trace amounts of the unoxidized mineral uraninite—a nuranium oxide, were noted in isolated occurrences, usually in the lower contact portion of the deposit.

The Mabel New deposit was the most important oxidized deposit mined in Live Oak Country. The average depth of the deposit was 90 feet, about 50 feet deeper than the oxidized deposits near Deweesville. The characteristics of Mabel New ore were completely different from other deposits. The ore minerals were boltwoodite—a uranium potassium silicate, and weeksite—a uranium potassium silicate high in calcium. The ore occurred as a bedded deposit in a host rock of ferruginous sandstone. The deposit was

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enclosed in a thin bed of fine-grained sandstone tightly cemented by calcite. It was the only deposit of this type in the district.

Unoxidized mineralization was discovered one to two miles downdip from the oxidized deposits in Karnes County in 1963. The principal host for such ores is fine-grained arkosic sandstone and clayey sandstone in beach environment and fluvial channel fill. Most of the unoxidized ore occurs in roll front-type deposits, with the unoxidized zone and the thickest and richest ore on the downdip side of the front. The main ore minerals are uraninite—a uranium oxide, and coffinite—a uranium silicate. Associated minerals consist of molybdenum, selenium and pyrite. The largest and most important ore deposits along the trend are completely unoxidized and occur in the Oakville Sandstone in Live Oak County.

Roll front deposits in sandstone facies of fluvial channels within the Soledad member of the Catahoula Tuff are important in Duval and Webb County. Ore grade mineralization is known to occur at depths of 2,000 feet or more in the Oakville and Catahoula formations; however, the deepest solution mining is currently between 600 and 700 feet. Due to the depth and low grade nature of certain deposits, in situ solution mining is considered the most practical method of recovery. Table 7 illustrates the geologic sequence of all uranium-bearing formations with relation to rated economic importance of each formation and the main area of mining activity.

Generally, the oxidized ores were characterized by an equilibrium difference between detectable radiation and actual uranium content of the ore. Detailed evaluation of a deposit by core drilling and chemical assaying of samples became an important procedure in final orebody studies. Exploitation of a deposit was dependent upon the proper interpretation of the disequilibrium factor. The problem of disequilibrium in unoxidized ore deposits has been minor to non-existent; even so, project evaluation procedures usually include precautionary measures such as core

Table 7

GEOLOGIC SEQUENCE OF THE URANIUM-BEARING FORMATIONS IN THE SOUTH TEXAS DISTRICT RATED BY ECONOMIC IMPORTANCE OF URANIUM DEPOSITS AND SHOWING THE PRINCIPAL AREAS BY COUNTIES.

Geologic Age	Geologic Unit	Economic Rank	County
Pliocene	Goliad Sandstone	1	Live Oak, Duval
Miocene	Fleming Formation		
	Oakville Sandstone	1	Karnes, Live Oak, McMullen, Duval, Jim Hogg, Dewitt
Oligocene	Catahoula		
	Chusa Tuff		
	Soledad Conglomerate	2	Duval, Webb
	Fant Tuff	5	Live Oak, Duval
	Frio Clay	6	Live Oak
Eocene	Jackson Group		
	(Whitsett Formation)		
	Fashing Clay		
	Tordilla Sandstone	3	Karnes, Wilson, Atascosa
	Dubose		
	Deweesville Sandstone	3	Karnes, Gonzales, Wilson, Fayette
	Conquista Clay		
	Dilworth Sandstone	6	Karnes

drilling and chemical assaying of core samples to determine if an equilibrium problem exists and what must be done to compensate for it.

Mining Activities

Approximately 6.7 million pounds U_3O_8 were produced in the South Texas district during 1980, making it the third largest production center in the U.S. Over 3.1 million pounds U_3O_8 were produced by open pit mining and conventional milling and about 3.6 million pounds by in situ solution mining techniques. In all, the South Texas district has existing production capacity for a total of at least nine to ten million pounds U_3O_8. However, it is unlikely that production for the next few years will exceed the 1980 level. Conventional production centers have already curtailed operations, or have plans to do so, and more than two-thirds of the 14 in situ solution mining pro- are operating below design capacity.

The largest conventional mining and milling operation in the district is the Conquista project which is controlled by Conoco and Pioneer Nuclear. Conoco is project operator. A 3,500 ton per day mill located at Deweesville, Karnes County is the center of activity. As of January 1981, project operations included 12 active mines in various stages of stripping, mining and pit reclamation in Karnes, Live Oak and Gonzales Counties. Operating depths are from 120 to 200 feet. (Figure 1 shows the stripping procedure at one of the Conquista projects.) Conquista currently has 27 active mining permits out of a total 36 issued to date. Even though project operations were curtailed 50 to 60 percent on January 1, permit number 37 for another open pit mine is pending. Past mining from the Whitsett formations has occurred in Wilson, Dewitt and Atascosa Counties. Figure 2 is a photo of the specialized equipment used by Conquista for mining ore.

Chevron Resources Company operates a 3,000 ton per day mill located at Panna Maria in eastern Karnes County. Mill feed is mined from three open pit mines at depths of 120 feet to 180 feet in the Whitsett sandstone units. Chevron has also applied for a mining permit on the Jack Pump ore deposit located about 16 miles northeast of the Panna Maria mill site. In a significant move to enhance uranium operations in the district, Chevron announced in December 1980 that it had signed a letter of intent with Union Carbide Corporation for the purpose of purchasing all mineral interest controlled by UCC on the Palangana and Rogers properties. It is contemplated that the ore reserves on the Rogers lease could be mined by open pit methods; the Palangana deposit will probably be mined by in site solution methods, although open pit mining could be a consideration.

The Anaconda et al joint venture has proposed an open-pit mine and conventional mill for the large ore deposit located on the Rhode Ranch in McMullen County. The original proposal indicated the mine and mill would support a production rate of 2,000 tons per day. However, it was announced in December 1980 that the project would be delayed indefinitely, pending improved market conditions for uranium. All property evaluation was discontinued at that time.

In situ solution mining, or in situ leaching, technology has advanced rapidly since it was first tested in the district about 1968. It is a highly sophisticated recovery method today, applied by 8 different companies or joint ventures at 14 fully operational in situ leach projects. One pilot plant is operating, two additional plants are under construction, three are in the permitting stage and one more has been proposed. Figure 3 shows the location, project status and ownership of each mining property along the mineral trend.

Uranium recovery for each plant is a function of the flow-through rate of lixiviant given in gallons per minute times the concentration of uranium in the feed. The recovery of uranium from the lixiviant is incidental to the actual leaching process. Throughput of a full production plant varies from about 500 gpm to about 10,000 gpm. Pilot plant operations are usually designed for initial flow below 200 gpm subject to one or two incremental increases to attain the desired throughput level. Upgrading a plant from the pilot stage to a satisfactory production level can be accomplished in six to nine months, depending upon testing time and required process modifications.

Actual U_3O_8 production by in situ solution mining for 1980 varied from less than 50,000 pounds U_3O_8 at the smaller operations to about one million pounds at the largest operations. The average production rate in 1980 for each of the 14 in situ plants was 257,000 pounds U_3O_8. One of the smaller operations is producing U_3O_8 by a modified in situ solution mining technique. Solution Engineering, Inc. is engaged in reclamation of residual uranium from impounded mill tailings at the Susquehanna Western, Inc. site near Falls City. The tailings are being treated by a

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Figure 1
HEAVY EQUIPMENT UTILIZED IN THE STRIPPING PROCESS AT CONQUISTA PROJECT MINES

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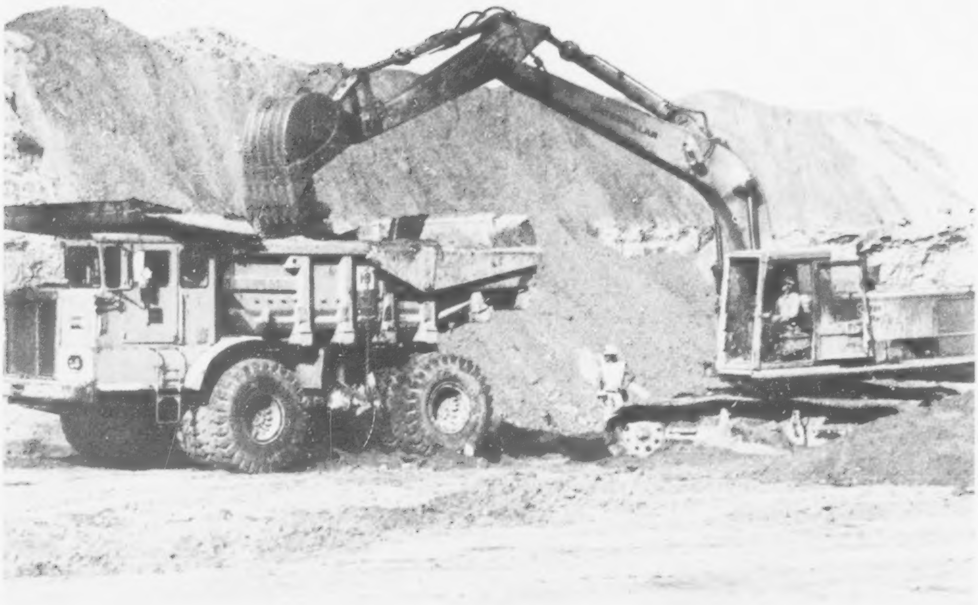

Figure 2
SPECIALIZED EQUIPMENT USED FOR ORE REMOVAL AT CONQUISTA PROJECT MINES

method called in situ heap leaching.

Leaching solution contact with the tailings is accomplished in a manner similar to conventional in situ solution mining. Well patterns are strategically located over the tailings to service the area to be leached. The residual acid content of the tailings provides the leaching agent which extracts already soluble uranium from the porous tailings. Feed to the recovery plant varies with the areas being leached, but generally contains 20 to 40 parts per million U_3O_8. The recovery plant has a capacity of 800 gpm featuring a countercurrent continuous ion exchange system and subsequent system to produce dry yellowcake.

Summary

Participation in exploration and development throughout the South Texas district has continued to gain favor because of exploration success and workable industry regulations. Several distinct mineral trends have been developed to date and new trends have been discovered at greater depths. Drilled reserves of the district are estimated by Nuexco at 140 million pounds U_3O_8; the potential to increase reserves by 50 percent is considered good to excellent. The new trend developing in the Oakville Sandstone through Jim Wells and the eastern part of Duval Counties has much potential. It is inevitable that exploration efforts will migrate eastward to test each uranium-bearing formation at ever-increasing depths.

New property development is completely under the jurisdiction of state agencies. The Railroad Commission of Texas is primarily responsible for open-pit mines; the Texas Department of Water Resources has the responsibility for in situ solution mining; the Department of Health and the Air Control Board contribute to final environmental requirements. Texas is an Agreement State and the Nuclear Regulatory Commission and the Environmental Protection Agency have only indirect jurisdiction. State agencies work in close cooperation with the industry to allow exploitation of uranium deposits. As a result, development of new properties has been steady during the last few years and the district has become one of the most active in the U.S.

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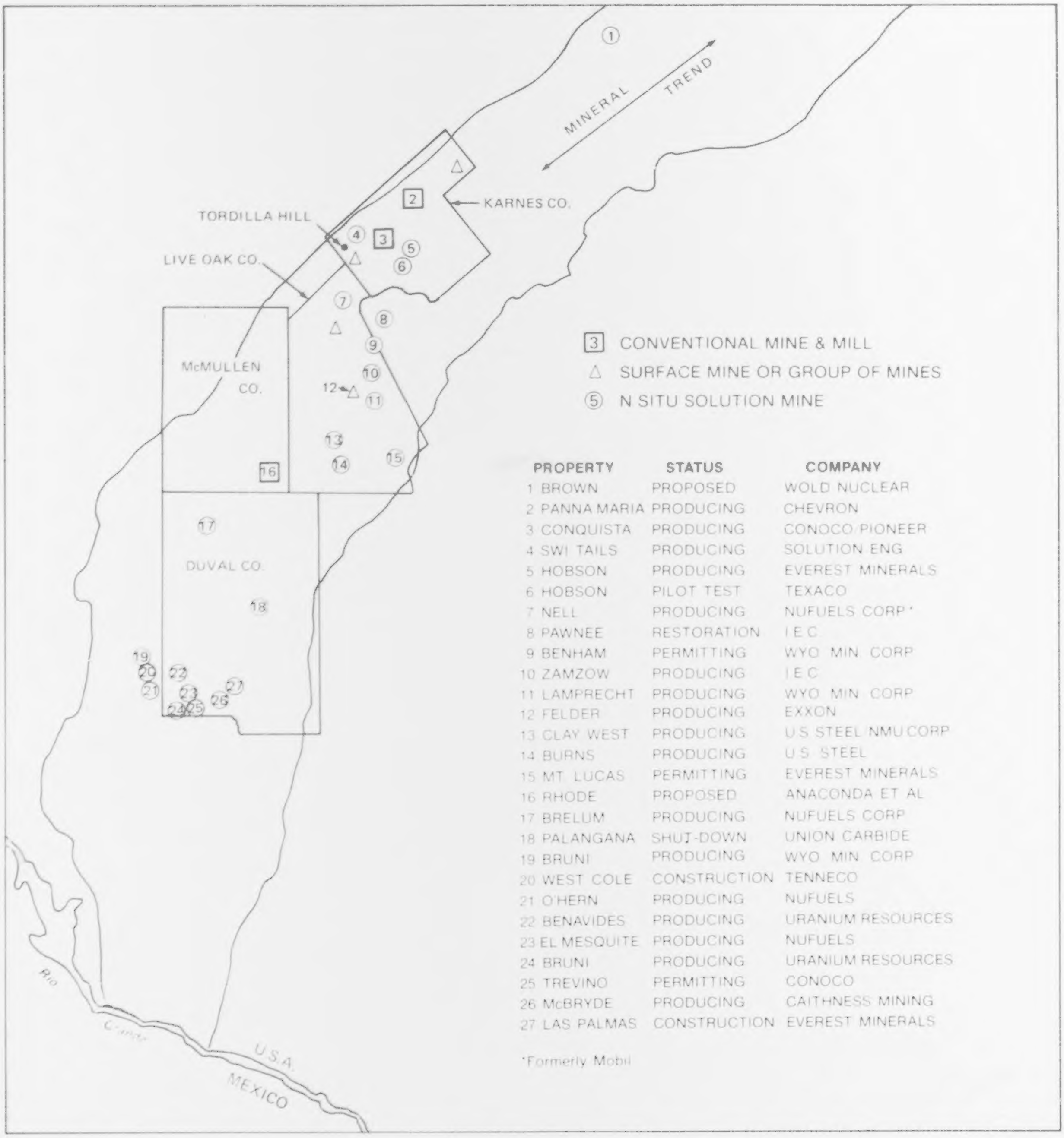
RAW MATERIALS


①
MINERAL TREND
2
KARNES CO.
TORDILLA HILL
4
3
5
6
LIVE OAK CO.
7
8
9
McMULLEN CO.
10
12
11
13
14
15
16
17
DUVAL CO.
18
19
20
21
22
23
24
25
26
27
Rio Grande
U.S.A.
MEXICO

3 CONVENTIONAL MINE & MILL

△ SURFACE MINE OR GROUP OF MINES

⑤ N SITU SOLUTION MINE

PROPERTY	STATUS	COMPANY
1 BROWN	PROPOSED	WOLD NUCLEAR
2 PANNA MARIA	PRODUCING	CHEVRON
3 CONQUISTA	PRODUCING	CONOCO/PIONEER
4 SWI TAILS	PRODUCING	SOLUTION ENG
5 HOBSON	PRODUCING	EVEREST MINERALS
6 HOBSON	PILOT TEST	TEXACO
7 NELL	PRODUCING	NUFUELS CORP*
8 PAWNEE	RESTORATION	I E C
9 BENHAM	PERMITTING	WYO MIN CORP
10 ZAMZOW	PRODUCING	I E C
11 LAMPRECHT	PRODUCING	WYO MIN CORP
12 FELDER	PRODUCING	EXXON
13 CLAY WEST	PRODUCING	U.S STEEL/NMU CORP
14 BURNS	PRODUCING	U.S STEEL
15 MT LUCAS	PERMITTING	EVEREST MINERALS
16 RHODE	PROPOSED	ANACONDA ET AL
17 BRELUM	PRODUCING	NUFUELS CORP
18 PALANGANA	SHUT-DOWN	UNION CARBIDE
19 BRUNI	PRODUCING	WYO MIN CORP
20 WEST COLE	CONSTRUCTION	TENNECO
21 O'HERN	PRODUCING	NUFUELS
22 BENAVIDES	PRODUCING	URANIUM RESOURCES
23 EL MESQUITE	PRODUCING	NUFUELS
24 BRUNI	PRODUCING	URANIUM RESOURCES
25 TREVINO	PERMITTING	CONOCO
26 McBRYDE	PRODUCING	CAITHNESS MINING
27 LAS PALMAS	CONSTRUCTION	EVEREST MINERALS

*Formerly Mobil

Figure 3

LOCATION, STATUS AND PRINCIPAL OWNERSHIP OF MINING PROPERTIES ALONG THE SOUTH TEXAS URANIUM TREND

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MAY 1981 NUMBER 153

Monthly Report on the Uranium Market

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MONTHLY REPORT ON THE URANIUM MARKET
May 1981 No. 153

JAMES E. VAUGHAN, *EDITOR* TERESA T. ELMS, *ASSOCIATE EDITOR*

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FOREWORD

The definition of the Conversion Value has been reworded this month to more accurately describe the data on which it is based.

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URANIUM MARKET

GENERAL

Issues concerning waste storage and disposal, including Away From Reactor (AFR) legislation, continue to be debated within the US Department of Energy (USDOE), the US Congress and among the American public. Meanwhile several European nations continue to proceed with research and testing and are putting disposal technologies into practical application. The use of geologic formations for disposal is being pursued in many European countries and the European Economic Community (EEC) is financing a joint program of study in this area, with different countries emphasizing various geologic approaches. The following is an update of the situation in Europe.

France:

France is probably making the most notable progress in practical application of technology. It is reprocessing its spent fuel and applying its highly developed technology, known as AVM, for vitrifying separated high-level waste. The AVM facility began operation with radioactive waste in June 1978. The facility produces glassified waste encapsulated in stainless steel canisters, which are stored in air-cooled pits adjacent to the processing plant. A similar waste processing plant is being designed for operation at Cogema's La Hague reprocessing plant.

France has an adequate interim storage system for vitrified high-level waste cylinders and is currently considering salt, crystaline rocks and argillaceous (clay) material for permanent waste disposal. An experimental repository is being discussed for completion within ten to 20 years.

United Kingdom:

The back end of the fuel cycle in the United Kingdom utilizes the British Nuclear Fuels, Ltd. (BNFL) Windscale reprocessing plant handling Magnox fuel. BNFL is storing light water reactor (LWR) fuel received from other countries until construction is completed at its new THORP reprocessing plant, designed to handle LWR and Advanced Gas-Cooled Reactor (AGR) fuels.

BNFL is focussing its research and development on solidification and permanent disposal of high-level wastes. These wastes are currently being stored in a liquid form in water-cooled stainless steel tanks at the Windscale site. Solidification is achieved by converting the radioactive liquid wastes into a highly durable glass. One process for this vitrification, the Fingal Harvest process, has been demonstrated with actual waste from Windscale. Pilot plants and industrial-scale facilities are being developed using this method.

Efforts toward final geologic disposal of the vitrified wastes include feasibility studies of various rock formations, primarily granites. There are current proposals to drill test holes in the Cheviot hills along the English Scottish border and in other areas of England as well. A conceptual design for a hard-rock repository is proceeding in parallel. A demonstration facility is planned for the 1990's with a full-scale repository targeted for the following decade. The United Kingdom is also directing effort toward deep-ocean disposal.

Federal Republic of Germany:

Nuclear fuel and waste disposal have been highly emotional issues in Germany, where control over programs resides as much with the states as it does with the federal government. The Biblis A and B nuclear plants were threatened with extended shutdowns for lack of ability to obtain state licenses for high density on-site spent fuel storage racks. The utility RWE recently signed a long-delayed reprocessing contract with BNFL to assure alternate storage capability.

Although most German utilities hold reprocessing contracts, most of the arrangements do not extend beyond 1984 or 1985. Intermediate storage, new reprocessing contracts or other solutions will be required by 1985. Reprocessing contracts with BNFL and Cogema require return of the waste to Germany, probably in glassified form sometime after 1990. In addition, Germany has plans to build its own reprocessing plant.

Salt domes have been selected as the preferred geologic media for disposal of the wastes from reprocessing. Initial disposal would be designed to be retrievable and final disposal would await further development and testing of geologic areas.

The German company DWK plans to build storage facilities at Gorleben and perhaps Ahaus. Both will be "dry" storage facilities with the fuel in casks or flasks. The cask designs have been tested and have been given preliminary licenses. An operating license for the storage area may be granted by mid-1981, which would mean start-up could be as early as 1983.

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However the anti-nuclear activity associated with the Gorleben site may delay these plans significantly.

To further study the waste disposal issue and to permit emotions to subside, Bonn's research ministry last year made plans for a $28 million program to effect decisions regarding the future of its nuclear waste storage by 1984.

Sweden:

Sweden has a law requiring that utilities have contracts for the reprocessing of spent fuel and for storage of the waste from such reprocessing as a prerequisite for nuclear plant start-up. This 1976 law applies only to the last seven plants of the 12 now committed for Sweden.

Sweden is building a temporary storage facility, referred to as CLAB, at the Oskarshamn site. This facility will eventually be able to store up to 3000 tons of spent fuel. The first phase, for 1500 tons, is expected to be ready in about 1985 or 1986. It has the design capacity to store all the fuel from the 12 reactors for up to 12 years. In parallel with building temporary storage for the spent fuel, Swedish electric power companies have entered into contracts with Cogema and BNFL for reprocessing. These contracts require that Sweden take back the waste from reprocessing for final storage in Sweden, but probably not before the early 1990's.

As to final waste disposal, Sweden has been carrying out a number of studies leading to probable storage in deep crystalline rock. One such study is the "stripa" program in conjunction with the USDOE. Very thorough research by a group of Swedish utilities concludes that both vitrified waste encapsulated in lead and titanium, or spent fuel encapsulated in copper canisters buried 1500 feet underground in crystalline rock will isolate the wastes from the environment for hundreds of thousands of years.

Switzerland:

The nuclear plants in Switzerland already have high density fuel storage racks to allow storage of spent fuel for a period of about five years. The Swiss utilities have contracts for reprocessing their spent fuel with Cogema and BNFL. The Swiss utility BKW recently received approval from the US to have some of its spent fuel reprocessed by Cogema where the fuel is in storage. Spent fuel from the Swiss utility NOK has been shipped to storage pools in England but reprocessing is not expected to be performed for about ten years. Each reprocessor has the option of retaining the waste from reprocessing or shipping it back to Switzerland. The exact form in which the waste would be returned is not yet determined, but would likely be calcined or glassified.

The Swiss are planning construction of long term storage facilities in various geologic formations. Granites appear to have the most promise but anhydrites, argillaceous formations and crystalline rocks other than granites are being studied. Switzerland's agency responsible for radioactive waste storage has a target date of 1985 for identification, safety analysis and engineering of a specific site or sites. Expenditures of more than $125 million over the next five years are planned.

Italy:

Latina fuel will be shipped to BNFL for reprocessing. Trino and Garigliani fuel will be stored in an AFR, developed from a former research reactor facility. Caorso fuel will be stored in on-site high density storage for about ten years.

The Italians are waiting for a determination of a national plan on spent fuel before further arrangements are made. At one time Italy planned to build its own reprocessing plant but this seems unlikely now.

In its waste management program, Italy is concentrating research on the disposal of radioactive waste in argillaceous formations in Southern Italy. Operations for a test repository are expected to start in the mid-1980's.

Belgium:

Currently, Belgian spent fuel is being stored on-site. The Belgian nuclear industry has proposed to reprocess about one-third of its spent fuel at the Eurochemic facility at Mol and the balance at Cogema's plant. The Belgian parliament has been asked to make a decision on this issue by the end of 1981. Research into the disposal of radioactive waste is focused on the potential use of argillaceous formations.

Holland:

The Dutch utilities have reprocessing contracts with BNFL and Cogema which require that the waste products be returned to Holland. However, nuclear opposition in the country is strongly against domestic storage of such wastes.

The Dutch parliament is currently discussing not only the waste storage issue but the future of the

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entire nuclear program. A period of public debate is planned before a final decision is made. This debate period may last as long as two years and thus a firm Dutch nuclear position is not expected very soon.

An active geologic waste isolation program is concentrated on salt dome repositories sited on state-owned properties. The Dutch commissioned seismic tests of salt domes in the Dutch sector of the North Sea in March of this year to determine their suitability for radioactive waste disposal.

Finland:

The private utility group TVO has on-site storage to accommodate about ten years of spent fuel. TVO is also negotiating to store fuel at the Swedish CLAB storage center as well as encouraging an interim centralized AFR storage facility in Finland. The state-owned utility IVO has two Russian-supplied nuclear plants and arrangements which require the spent fuel to be returned to Russia. A study is being conducted which will lead to final long term storage of spent fuel. There are currently no plans to reprocess the fuel.

Spain:

Spain has on-site spent fuel storage capacity adequate for the near-term needs of its new nuclear plants. The country has reprocessing contracts for its four operating nuclear plants. Consideration is being given to an AFR facility as well. Spain has not yet focused much attention on long term waste disposal.

AFRICA

First quarter figures from South African producers have been released and while total uranium production remained unchanged from the previous quarter's 1859 metric tons, profits were down substantially.

Vaal Reefs, South Africa's largest producer, reported a 19 percent decrease in profits from uranium sales this quarter, as compared to the previous quarter. Production from the Afrikander Lease section was down 66 percent from the previous quarter due to ore stockpiling. The ore is being accumulated in order to commission the new 50,000 ton-per-month plant at Afrikander Lease during the first half of 1982. The chairman of Afrikander Lease has stated that the sales contract for the company's 1984 through 1990 uranium production, signed in 1980, might be supplied by Vaal Reefs from its own sources and at production costs well below those of Afrikander Lease. In this event, the mineral lease agreement between Vaal Reefs and Afrikander Lease would be renegotiated to ensure that royalty receipts would be shared in the same way as would have been the case had Afrikander Lease been the supplier.

An industry perspective on the uranium market was recently put forth by Mr. D. A. Etheredge, Chairman of Anglo-American's gold and uranium division. Mr. Etheredge attributed the past year's dramatic decline in uranium spot prices to reduced projections of demand for power generation, the development of new high-grade ore bodies and US utility inventory sales. While anticipating an increase in uranium inventories in the medium term, he forsees a longer term change of direction in the trends of supply and demand. He also mentioned the aggressive Australian pricing policy and general utility desire for diversified suppy sources as factors with which South African uranium producers must contend.

Mr. Etheredge pointed out to shareholders that the declining uranium spot price was accentuated in South Africa by the appreciation of the rand relative to the dollar. He acknowledged that improvement in spot prices was unlikely and mentioned customer pressure to modify existing contracts as a corollary to the situation.

AUSTRALIA

The action of the Seaman's Union effectively to ban the shipment of uranium from Australia is not expected to have serious or long term ramifications. To place the situation in perspective, minerals represent nearly 40 percent of Australia's export income. Given this importance, it is clear that the Australian government desires to maintain its reputation as a reliable supplier. Thus it is unlikely that the situation will be permitted to proceed unchecked. At the same time, government intervention is not expected until the various industry-labor alternatives have been fully explored. For the short term there are other methods of moving the modest amount of concentrates out of the country including air shipment, the use of foreign-crewed vessels and the use of alternate ports of export.

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The government of the Northern Territories has suspended all plans for a nuclear station near Darwin on both economic and constitutional grounds.

The Uranium Enrichment Group of Australia (UEGA), a joint-venture by several Australian companies, is shortly expected to file its findings with the government concerning the possibility of establishing a commercial uranium enrichment industry in Australia. It is anticipated that the report will recommend a full scale feasibility study and that the study will begin near year-end.

Euratom member nations are now reviewing the Australian bilateral safeguards agreement and formal approval is expected in the next few weeks. In the meantime, it is expected that negotiations towards a similar safeguards agreement between Japan and Australia will be resumed.

Minatome Australia Pty., Ltd. has encountered a setback in the development of the Ben Lomond deposit in Queensland. The mining warden has recommended that the company's application for a large additional lease be rejected. The land was to have been used for the location of the mill, tailings dams and evaporation ponds.

The state goverment could overrule this recommendation but will likely require new ground investigation before doing so. Although the present Queensland goverment is strongly pro-development including pro-uranium, state legislation provides for a wide range of Aboriginal and environmental matters and any action must be determined with the various interests taken into account.

At Mary Kathleen Uranium Ltd.'s annual meeting the chairman hinted that mine closure might occur 18 months ahead of schedule due to the current low price of uranium. Ore which is potentially economic will have been completely mined by mid-1983. This announcement reenforces the government position that further development of the Australian uranium industry depends on consumer demand as expressed in the conclusion of long term contracts.

CANADA

At the annual meeting of Rio Algom Ltd., it was reported that the Panel uranium mine and mill at Elliott Lake are now in normal operation with a high level of performance. Because of startup problems which were not corrected until late 1980, profitability of the Panel operation was not achieved until the last four months of the year.

Construction at the Stanleigh property is also on schedule and within budget, with production planned to begin in 1983. Through the end of March 1981, $137,000,000 has been spent or committed. The financing is being provided by Ontario Hydro, which has contracted for the total production from Stanleigh.

Long term contracts involving the supply of uranium from Saskatchewan are finally beginning to materialize. Marketing efforts have been very aggressive. It is understood that agreements in principle have been reached between Canadian sellers and both Japanese and US buyers. Several contracts are expected to be completed and signed within the next few months.

FAR EAST

The release, due to operator error, of radioactive waste water at Japan Atomic Power Co.'s Tsuruga station received considerable media attention, including charges that the incident was the subject of a cover-up. Despite the public attention, the release itself was not serious and will have no real effect on Japan's nuclear program. The likely outcome includes reassignment of certain personnel, tightening of inspection and reporting procedures and compensation payments to the local marine industry for lost business.

On a more positive note, Kyushu Electric Power Co.'s 559 MWe Genkai unit 2 was successfully brought on line in late March 1981 bringing Japan's nuclear capacity to 15,676 MWe.

Continuing the trend evident in recent market price negotiations, it is understood that 1982 deliveries from Southern African suppliers to Japanese customers will be priced somewhat lower than 1981 deliveries. Thus while prices under long-term supply contracts with provisions for negotiation of market price tend to move in the same direction as spot prices, their movement is usually more gradual and less erratic.

Discussion of Japan's nuclear program appears in the *Topical Essay* section of this month's Report

URANIUM MARKET

UNITED STATES

The two previous Monthly Reports (Nos. 151 and 152) have summarized and updated the status of uranium industry litigation. Further developments during April were as follows:

1. Westinghouse Richmond case: this long running dispute was concluded as Westinghouse and Long Island Lighting Company (LILCO) reached agreement on a settlement. LILCO will receive cash ($51 million), discounts on products and services and an option to purchase one million pounds U_3O_8 over a five-year period.

2. Westinghouse Chicago case: Additional settlements have been reached by Westinghouse with Phelps Dodge Corp., Anaconda Co. and Western Nuclear, Inc. Counter claims by the latter two defendants were also settled. Details of these settlements are unknown at this time, but based on past record, will probably involve Westinghouse receiving money, uranium or some combination thereof.

Thus, officially only Australia's Queensland Mines Ltd. and Englehard Minerals and Chemicals Corp. remain as defendants in this case. However, based on recent public statements by Westinghouse, it appears that a settlement with Queensland Mines has also been effected, although not yet announced. In view of the pace of settlements during the past few months, it is anticipated that the entire affair will soon be concluded.

A recent announcement added Exxon Minerals Co. to the long list of US producers cutting back uranium production due to depressed market conditions. Production at Exxon's Highland uranium complex near Douglas, Wyoming will be reduced about one-third, as will the number of employees. The mill, running at a level of 3,200 tons per day, will go to a ten days on, four days off cycle. Overburden stripping at the surface mine will be cut back one-half in 1981.

It was announced this month that United Nuclear Corp. (UNC) had sold off its interest in the UNC-Homestake Partners operations near Grants, New Mexico to Homestake Mining Co. UNC originally owned 40 percent of the four uranium mines and one mill. The price to Homestake was 20 million dollars for the properties and three million dollars for yellowcake inventories.

TRANSACTIONS

There are six uranium transactions reported this month. A longer term sale of between six and ten million pounds of Australian U_3O_8 was concluded with a European utility consortium. The transaction involved a resale of material by European equity owners of Energy Resources of Australia (ERA). A sale of between 300 thousand and 600 thousand pounds U_3O_8 took place between a US producer and a US utility. Deliveries on this contract will stretch into 1982.

Two small spot quantities were sold to a US producer by two other US producers. A sale of between 100 thousand and 300 thousand pounds U_3O_8 was made between a US producer and a US utility. Finally, an agreement providing for the delivery of between 600 thousand and one million pounds U_3O_8 over the next three years from a US nuclear contractor to a US producer was completed.

There are two conversion transactions reported this month. One concerns the sale of between 600 thousand and one million pounds U of conversion in the period 1982-1983. The seller is a US nuclear contractor and the buyer is a US utility. A second transaction involves between 100 and 300 thousand pounds U of conversion for 1981 delivery. The parties are two US utilities.

PRICING

The **Exchange Value** as of April 30, 1981 is $25.00 per pound U_3O_8, unchanged from the three previous months. The most important factors considered in the determination of this month's Exchange Value were:

1. More than ten million pounds of concentrates are still under negotiation at prices approximately equal to the current Exchange Value.

2. A large transaction closed recently at about Exchange Value.

3. Nuexco continues to receive indications that producer-buyers could add significant new near term and intermediate term demand as they evaluate their options at what is apparently a very attractive price level.

4. In last month's Report, Nuexco noted that some price weakening had begun to appear as some sellers offered material at prices somewhat below Ex-

change Value. That trend continued during April, in which some transactions occurred at less than $25.00. Those transactions involved several hundred thousand pounds U_3O_8, a quantity which would be significant in some cases but is commercially insignificant in today's market.

Material available for near term delivery as listed in the *Market Opportunities* section of this Report, total 7.06 million pounds U_3O_8. Active inquiries in the same time frame to purchase amount to 1.55 million pounds U_3O_8. Available near term supply remains at the highest level in recent years. Approximately one-half of this near term material is being offered by primary producers; the balance is being offered by holders of inventory.

The **Transaction Value** declined to $25.70 per pound U_3O_8 from last month's level of $27.00. Four qualifying transactions took place; transactions from 1981 account for approximately two-thirds of the material which went into this month's calculation of Transaction Value. Transactions from the fourth quarter of 1980, when prices were substantially higher than today's Exchange Value, which dominated last month's Transaction Value, accounted for only one-third of the material included in this month's Transaction Value.

CONVERSION

The secondary market for conversion services maintained its high level of activity during April. The market continues to be grossly imbalanced in the spot and near term. As presented in the *Market Opportunities* section of this Report, demand for secondary market conversion services within the next year totals 200,000 pounds U as UF_6. Supply in the same time frame totals 2.25 million pounds U as UF_6.

The preponderance of sellers are utilities wishing to obtain concentrates through deconversion of their UF_6 inventories with the eventual aim of selling the material. The concentrates are more salable in today's market. The low demand in the near term occurs in part because most utilities in need of converted material in the upcoming year have already covered their conversion needs.

The supply-demand imbalance appears to decrease in the next several years. However the spot supply, if not sold, will continue to be available and could be pushed into the longer term thus sustaining the unequal supply-demand ratio and continuing pressure on the market. There is presently a strong demand for long term secondary market conversion services.

Most of the potential sellers in the longer term are utilities which have contracted with a primary converter for conversion services which they no longer need. These utilities are turning to the secondary market as a means of assigning or subcontracting their conversion services contracts. Utilities with conversion requirements in the longer term have expressed interest in taking advantage of the generally lower conversion prices in the secondary market.

The **Conversion Value** increased 20 cents to $1.40 per pound U as UF_6. The recent upward price movement in the midst of a supply overhang can be explained by the fact that those sellers willing to deconvert at lower prices have gradually been removed from the market as transactions have taken place. In addition, the incurred costs of implementing a deconversion swap or contract reassignment, including storage costs, have been receiving more attention from sellers now active in the market.

Two transactions for conversion services in the secondary market closed this month at around Conversion Value. The prices for conversion services in the longer term secondary market are generally higher than Conversion Value which by definition expresses the spot and near term price.

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TOPICAL ESSAY

WORLD DEMAND: PART II, NON-US

In Nuexco Report 151, the *Topical Essay* dealt with the differences between Demand and Apparent Future Consumption (AFC) in the United States. This essay continues the discussion by presenting Nuexco's estimate of demand in the non-US free world countries.

AFC is Nuexco's calculation of the portion of demand which corresponds to reactor requirements. It is compiled and computed on a reactor by reactor basis, with the quantities for each reactor being based on specific core characteristics, 0.25 percent tails assay, no recycling, 24 month lead time for procuring first cores and 18 month lead time for procuring each reload. Reloads are assumed to occur one year after the commercial operating date and annually thereafter except in those instances where alternate schedules are known to be used by the utility. Nuexco's estimates of individual reactor capacity factors are used. Thus, AFC is a strictly quantitative calculation which does not allow for inventory buildup or liquidation.

Demand, of which AFC is a significant component, includes the intangible market perceptions of each utility. Factors such as price, security of supply, political actions and inventory situations influence each buyer's view of the market. Nuexco has developed a data base which reflects these views.

The aggregate demand for non-US utilities as estimated by Nuexco is tabulated by region in Table 1. Table 2 breaks this down by presenting the difference between demand and AFC. The AFC numbers published in Nuexco Report 147 are used for this comparison. It is seen in Table 2 that demand is significantly larger than AFC in the Far East. Historically, the countries of Taiwan, Korea and especially Japan, being without indigenous resources, have placed security of supply as their highest priority. They perceive their needs to be much greater than a purely quantitative analysis would indicate.

Similarly, both the European and Other World Outside Communist Areas (WOCA) regions have demand levels in excess of AFC, although not to the degree of the Far East. The explanation for the difference lies again in the buyers' expanded perception of needs, as well as optimistic views of reactor start-up dates. Although there are many individuals within the various nuclear utility organizations who realize that the commercial operating dates and utility demand estimates are unreasonable, the utility as a whole officially holds to its target dates. The responsible fuel manager is expected to prepare for these needs, however unrealistic. This attitude is quantified in the demand category.

In one sense, the demand numbers representing buyers' perception of fuel requirements deviate from the AFC numbers even more than the quantitative difference would indicate. Specifically, there are many situations where a utility which had anticipated an early operating date for a reactor has already purchased fuel for a first core and even some reloads, but has subsequently delayed the on-line date for a number of years. In such cases, there is no demand for this already purchased material. But there is an AFC component because the algorithm states that the first core component appears two years before the operating date.

Table 3 shows the component of non-US utility demand which is currently unfilled by contracts. This has been computed on a utility by utility basis. Not surprisingly, buyers in the Far East have almost completely filled their perceptions of demand in the 1980's. The European market appears to have the most potential in the coming decade for sellers with uncommitted production, while buyers in the Other WOCA have relatively insignificant purchasing potential.

Table 4 fills out the picture by showing the portion of non-US production which is currently unsold. These figures have been compiled on a producer by producer basis, similar to the procedure used in determining utility demand. The contrast between Table 3 and Table 4 is dramatic, for it shows that on a cumulative basis there is roughly three times as much material available for sale in the coming decade as there is demand for such material.

A later essay will explore the implications of the differences between demand and AFC and will also integrate the US and non-US demand, unfilled demand and unsold production figures published in these first two essays.

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TOPICAL ESSAY

Table 1

NON-US DEMAND

(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	8.0	12.4	13.7	16.2	18.2	21.0	20.9	22.3	22.1	22.5
Europe	32.3	39.5	39.6	44.9	42.8	46.8	51.2	48.0	49.1	49.0
Other WOCA	4.0	5.3	6.5	6.3	7.0	7.4	8.7	8.6	7.9	9.1
Total Non-US:	44.3	57.2	59.8	67.4	68.0	75.2	80.8	78.9	79.1	80.6
Cumulative:	44.3	101.5	161.3	228.7	296.7	371.9	452.7	531.6	610.7	691.3

Table 2

NON-US DEMAND LESS AFC

(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	1.1	5.5	6.9	5.1	6.5	9.4	10.2	12.7	13.6	13.8
Europe	6.7	10.6	4.2	14.1	6.5	8.8	6.3	5.6	5.8	6.3
Other WOCA	0.9	0.2	0.6	1.2	2.4	1.5	1.2	1.6	2.3	3.0
Total Non-US:	8.7	16.3	11.7	20.4	15.4	19.7	17.7	20.0	21.7	23.1
Cumulative:	8.7	25.0	36.7	57.1	72.5	92.2	109.9	129.9	131.6	154.7

Table 3

NON-US UNFILLED DEMAND

(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	0.0	0.1	0.1	0.1	0.3	1.8	1.3	4.3	3.4	6.4
Europe	1.5	1.7	3.3	3.7	3.9	5.5	5.7	6.9	8.4	7.4
Other WOCA	0.4	0.7	1.8	1.6	2.3	1.6	1.9	2.6	1.9	2.2
Total Non-US:	1.9	2.5	5.2	5.4	6.5	8.9	8.9	13.8	13.7	16.0
Cumulative:	1.9	4.4	9.6	15.0	21.5	30.4	39.3	53.1	66.1	82.1

Table 4

NON-US UNSOLD PRODUCTION

(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual:	11.5	13.5	13.6	17.8	21.6	26.1	28.1	28.9	30.1	29.4
Cumulative:	11.5	25.0	38.6	56.4	78.0	104.1	132.2	161.1	191.2	220.6

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TOPICAL ESSAY

JAPAN'S NUCLEAR GROWTH: HOPE VS. REALITY

A reduced reliance on imported oil remains one of Japan's fundamental goals. Among the available alternate fuel sources, nuclear power has been selected to play a major role, and Japan continues to press forward despite slowdowns associated with lower load growth, less favorable economic conditions, more difficult and time-consuming siting and licensing procedures and Three Mile Island (TMI)—related delays.

The official nuclear capacity forecast, supported by both the government and the utility industry, remains at 51,000 MWe by the end of fiscal year 1990. Including the newly operational Genkai unit 2, Japan's current capacity is 15,676 MWe. This leaves more than 35,000 MWe to be brought on line in order to achieve the official forecast. The 35,000 MWe can be broken down as follows:

1. About 10,000 MWe are currently under construction with official operating dates scheduled between 1981 and 1986.
2. About 3,000 additional MWe have been approved by the Electric Power Resource Development Coordinating Council as part of Japan's official generating plan. Even though these units have yet to receive construction licenses, they are, nevertheless, scheduled for operation in 1985 and 1986.
3. Another 18,000 MWe are planned, but have yet to go through procedures for authorization and construction license application.
4. This leaves 4,000 MWe that have not yet reached even the planning stage.

Japan has begun to consider modifying the existing lengthy procedures involved in project authorization and safety licensing, but there seems to be no immediate solutions to the current siting and licensing problems. Without such solutions, it is doubtful whether Japan can achieve a goal of bringing on line some 2,000 MWe each year between 1981 and 1985 along with an average of 4,700 MWe annually in the period 1986-1990.

Despite the official forecast, non-official estimates for 1990 capacity continue to range in the area of 35,000 to 45,000 MWe, with a general view that the achievement of 40,000 MWe would be a very credible performance and indeed would be possible only under extremely favorable circumstances.

One development that could increase the chances to approach or meet the official target is increased cooperation among nuclear utilities. In mid-April, Kansai Electric Power Co., Chubu Electric Power Co. and Hokuriku Electric Power Co. announced their intent to organize a joint venture to promote further construction of nuclear power generating plants. The objective of the new company, tentatively called the "Noto Nuclear Development Co." is to develop a new nuclear plant site in the western part of the main Japanese island of Honshu. The site selected, known as Suzu, is located at the extreme end of the remote Noto peninsula in Hokuriku's operating area.

The announcement indicated that total generation capacity to be installed would be approximately 10,000 MWe consisting of both Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) units. No particular schedule for construction of the plants was given in the initial announcement. Although extensive site reviews have been made over the past few years, it is expected that extended negotiations will be required to gain the agreement of local residents and environmentalists.

As conceived, the new company would be jointly owned by the three utilities and the output of the generating facilities would be shared in proportion to the capital investment of each of the three owners. Capitalization of the new company was estimated at about $1.8 billion. It is hoped that the company can be established by mid-1981. Current cost estimates for completion of the planned 10,000 MWe capacity are $13.5 billion with an additional $1.5 billion required for new transmission facilities. If achieved, the final installed capacity of 10,000 MWe will exceed that of Tokyo Electric Power Co.'s (TEPCO) Fukushima plant site. The latter, with six BWRs, (4,696 MWe) currently operating, will eventually have ten units with a total capacity of about 9,000 MWe when completed by the mid-1980's.

In a parallel development, TEPCO and Tohoku Electric Power Co. announced further cooperation in sharing nuclear generation capacity. The two utilities have adjacent service areas. TEPCO has already started construction of the 1,100 MWe Kashiwazaki unit 1, a BWR with operation scheduled for 1985. TEPCO also is well along with licensing approval for two additional 1,100 MWe BWRs, Fukushima 2 units 3 and 4, scheduled for operation in 1985 and 1986, respectively.

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TOPICAL ESSAY

TEPCO and Tohoku have reached preliminary agreement providing Tohoku with 50 percent of the output of the Kashiwayaki plant and 25 percent of the latter two Fukushima 2 units. The intent is to supply Tohoku, which currently is relying primarily on fossil fuel generation, with the more economic generation available from TEPCO's nuclear plants. Tohoku currently has no nuclear generation due to extended licensing delays of its 524 MWe BWR at Onagawa, now scheduled for 1984 operation. Tohoku's subsequent nuclear plans call for operation of its planned Maki and Namie-Odaka plants, both 825 MWe BWRs, in approximately 1989-1990. It is expected that at the latter time there may be some additional supply from Tohoku to TEPCO.

In return for the commitment to supply electricity from the Kashiwayaki and Fukushima plants, Tohoku will make a one-time payment estimated at $135 million for defrayed construction costs. In addition, TEPCO and Tohoku recently announced plans to jointly develop an 1,100 MWe BWR at the new Shimokita site in Tohoku's operating area.

This trend among Japanese utilities to cooperate more closely could prove to be extremely helpful in overcoming and licensing problems and in advancing Japan's nuclear program in a more rapid fashion.

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AUSTRALIAN URANIUM DEPOSITS

Introduction

The six major uranium deposits in Australia contain approximately 89 percent of the country's known uranium reserves.[1] The remaining 11 percent of reserves, which based on public information are estimated at 49,550 tonnes U_3O_8, occur in at least 11 minor deposits which are widely scattered throughout Queensland, South Australia and Western Australia. It is recognized that the smaller deposits represent only limited economic potential compared to the larger deposits; however, the fact that the deposits often occur in a totally different geologic environment increases the importance of each relative to creating new exploration potential. Historically, new exploration activities have resulted in the discovery of significant ore reserves.

The first uranium deposits mined in Australia were located in the Rum Jungle and South Alligator River districts of the Northern Territory and the Radium Hill Mount Painter districts in South Australia. Production was initiated in 1953 and 1954 respectively. Initial production at Mary Kathleen in northern Queensland began in 1956. Approximately 15 to 20 mines were producing in Australia by the late 1950's. Mary Kathleen is the only first generation mine surviving from this early production period.

Geologic interpretation of the early deposits led exploration groups toward the larger deposits in the early 1970's. The ultimate success story relates to the northward extension of the South Alligator River district into what is now the East Alligator River district—the location of four major ore deposits. The geology of these two districts, as well as the Rum Jungle district, is very similar. The situation repeated itself in other districts as exploration spread to geologically favorable areas, resulting in some cases, to new discoveries.

The Minor Deposits

The mode of mineral occurrence in the 11 minor uranium properties varies considerably by district. The properties are usually closely spaced, illustrating the relationship of a new discovery and follow-up exploration in a favorable geologic environment. The properties are tabulated to reflect highlights and current status of each. Figure 1 shows the geographic location of each in relation to other uranium properties in Australia.

Queensland

1. Property:	Westmoreland	
Ownership:	Queensland Mines Ltd.	40.00%
	Mines Administration P L.	12.75%
	I.O.L. Petroleum	9.75%
	Urangesellschaft Aust. P L.	37.50%
Ore Reserves:	4,700 tonnes U_3O_8 in the Garee and Jack orebodies. Grade is 0.17 percent U_3O_8.	
Occurrence:	Mineralization occurs in two tabular feldspathic sandstone units separated by a vertical dike and fault system in the Westmoreland Conglomerate of Upper Proterozoic age. The main ore mineral in the Garee zone is pitchblende; the Jack unit is dominated by secondary minerals of torbernite and carnotite.	
Current Status:	Evaluation drilling is continuing on a limited basis.	

2. Property:	Valhalla
Ownership:	Queensland Mines Ltd.
Ore Reserves:	5,800 tonnes U_3O_8; average grade is 0.16 percent U_3O_8.
Occurrence:	Metatorbernite occurs in a weathered portion of a steeply dipping stratabound tuff unit. Brannerite occurs in the unoxidized zone at a depth of about 35 meters.
Current Status:	Although ore was discovered in 1954, the evaluation procedures are limited to permit obligations.

3. Property:	Maureen	
Ownership:	Central Coast Exploration NL	51.00%
	Getty Mining Pty., Ltd.	49.00%
Ore Reserves:	3,600 tonnes U_3O_8; average grade is 0.14 percent U_3O_8.	
Occurrence:	Uraninite occurs in lenticular sediments within the lower portion of the Galloway volcanics of Middle Carboniferous age. Fluorite and molybdenum occur as accessory minerals.	
Current Status:	Evaluation drilling is continuing on a limited basis.	

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[1] The six deposits containing approximately 413,000 tonnes U_3O_8 are listed as Nabarlek, Jabiluka, Ranger and Koongarra located in the Northern Territory; Yeelirrie, located in Western Australia; Mary Kathleen, located in Queensland. Reserves are defined as U_3O_8 recoverable within a given cost range based upon current mining and milling technology.

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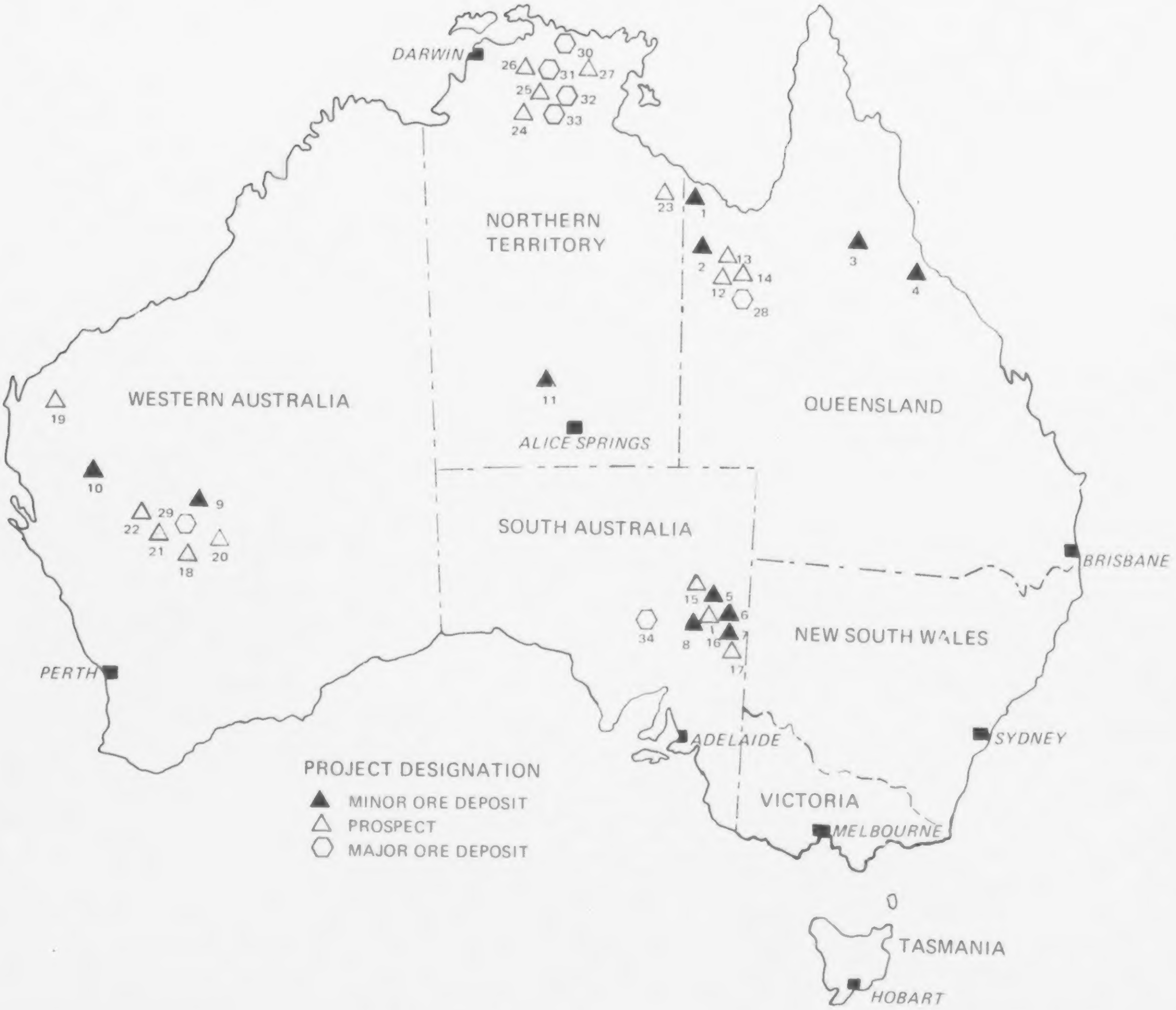
DARWIN
30
26
31
27
25
32
24
33
NORTHERN TERRITORY
23
1
2
13
12
14
28
3
4
WESTERN AUSTRALIA
19
11
ALICE SPRINGS
QUEENSLAND
10
9
29
22
21
18
20
SOUTH AUSTRALIA
BRISBANE
15
5
6
34
8
16
7
17
NEW SOUTH WALES
PERTH
ADELAIDE
SYDNEY
VICTORIA
MELBOURNE
TASMANIA
HOBART
PROJECT DESIGNATION
▲ MINOR ORE DEPOSIT
△ PROSPECT
⬡ MAJOR ORE DEPOSIT

SMALL URANIUM DEPOSIT

1. Westmoreland
2. Valhalla
3. Maureen
4. Ben Lomond
5. Beverley
6. Honeymoon
7. East Kalkaroo
8. Goulds Dam
9. Lake Way
10. Minindi Creek
11. Bigryli/Walbiri

URANIUM PROSPECT

12. Cloncurry
13. Skal
14. Anderson Lode
15. Mt. Painter
16. Yarramba
17. Mt. Victoria
18. Lake Raeside
19. Manyingee
20. Thatchers Soak
21. Lake Marmion
22. Mt. Joel
23. Pandanus Creek
24. Mt. Bundey
25. AAEC Prospect
26. Barote
27. Beatrice/Caramal

MAJOR URANIUM DEPOSIT

28. Mary Kathleen (Operating Mine & Mill)
29. Yeelirrie
30. Nabarlek (Operating Mill)
31. Jabiluka
32. Ranger (Developing Project)
33. Koongarra
34. Olympic Dam

Figure 1
URANIUM DEPOSITS OF AUSTRALIA

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RAW MATERIALS

4. Property: Ben Lomond
Ownership: Minatome Australia Pty., Ltd.
Ore Reserves: 3,200 tonnes U_3O_8; average grade is 0.30 percent U_3O_8.
Occurrence: Uraninite and coffinite mineralization occurs in Carboniferous volcanics and granites and gneisses.
Current Status: An environmental study is in progress and a mining application has been submitted. Initial production is scheduled for 1985 at an annual rate of about 360 tonnes U_3O_8.

South Australia

5. Property: Beverley
Ownership: Western Uranium Ltd. (subsidiary of Phelps Dodge) 50.00%
Oilmin NL 16.66%
Petronin NL 16.66%
Transoil NL 16.66%
Ore Reserves: 16,000 tonnes U_3O_8; average grade is 0.28 percent U_3O_8.
Occurrence: Uraninite mineralization occurs in roll-front deposits within paleochannel sand lenses of Eocene and Miocene (Tertiary) age at a depth of 120 meters.
Current Status: An in situ leach pilot plant may be operating in July or August this year; full production of about 1,350 tonnes U_3O_8 is scheduled for 1984.

6. Property: Honeymoon
Ownership: M.I.M. Holdings, Ltd. 49.00%
AAR Ltd. 21.70%
Teton Drilling Co. Pty., Ltd. 12.75%
North Kalgurli Mines Ltd. 12.75%
IOL Petroleum Ltd. 3.8%
Ore Reserves: 3,400 tonnes U_3O_8; average grade is 0.22 percent U_3O_8.
Occurrence: Coffinite mineralization occurs in roll-front deposits associated with paleochannel sands of Eocene and Miocene age.
Current Status: An in situ leach pilot plant is scheduled to be operational by August this year. Annual production could total about 400 tonnes U_3O_8 by 1983 or 1984.

7. Property: East Kalkaroo
Ownership: Carpentaria Exploration Co. Pty., Ltd. 49.00%
ARR Ltd. 21.67%
Teton Drilling Co. Pty., Ltd. 12.75%
North Kalgurli Mines Ltd. 12.75%
IOL Petroleum Ltd. 3.83%
Ore Reserves: 1,100 tonnes U_3O_8; average grade is 0.15 percent U_3O_8.
Occurrence: Coffinite mineralization occurs in roll-front deposits associated with paleochannel sands in the upper Miocene sequence of Tertiary age.
Current Status: Recovery by in situ leaching is being considered.

8. Property: Goulds Dam
Ownership: CSR Ltd. 51.00%
Mines Administration Pty., Ltd. 24.50%
Teton Drilling Co. Pty., Ltd. 12.25%
North Kalgurli Mines Ltd. 12.25%
Ore Reserves: 1,800 tonnes U_3O_8; average grade is 0.12 percent U_3O_8.
Occurrence: Uraninite mineralization occurs in roll-front deposits in paleochannel sands of Eocene and or Miocene age at a depth of about 110 meters.
Current Status: Recovery by in situ leaching is being considered.

Western Australia

9. Property: Lake Way
Ownership: Delhi International Oil Corp. 53.50%
Vam Ltd. 46.50%
(Wyoming Mineral Corp. recently sold its 51 percent interest to Delhi and Vam)
Ore Reserves: 6,400 tonnes U_3O_8; average grade is 0.10 percent U_3O_8.
Occurrence: Carnotite mineralization occurs in calcrete developed along drainage channels entering Lake Way; age is late Tertiary. The deposit is very similar to the larger Yeelirrie deposit.
Current Status: Development and environmental studies are in progress.

10. Property: Minindi Creek
Ownership: Cliffminex NL, Metals & Energy Minerals NL, et al.
Ore Reserves: 1,000 tonnes U_3O_8; average grade is 0.10 percent U_3O_8.
Occurrence. Carnotite mineralization is associated with calcrete along drainage channels.
Current Status: An in situ leach recovery system is planned to produce about 900 kg U_3O_8 per day.

Northern Territory

11. Property: Bigryli Walbiri (Ngalia Basin area)
Ownership: Urangesellschaft mbH & Co. 36.80%
AGIP Nucleare Australia Pty. Ltd. 36.80%
Central Pacific Minerals NL 16.00%
Australian Atomic Energy Comm. (AAEC) 10.40%
Ore Reserves: 2,550 tonnes U_3O_8 in two deposits; weighted average grade is 0.27 percent U_3O_8.

Occurrence: Carnotite mineralization fills joints and fractures in the faulted and weathered zone of the lower unit of the Mount Eclipse Sandstone of Carboniferous age. Uraninite is the main ore mineral in the deeper unoxidized zones of the prospect.

Current Status: Activity limited to the maintenance of exploration licenses.

Other Prospects

For every uranium deposit discovered, there follows numerous prospects to be evaluated. Some prospects are quickly determined to have little or no economic potential; the more favorable prospects require considerable evaluation. Presently there are many prospects being evaluated throughout the known uranium districts of Australia.

The economic potential of a prospect will be influenced by various factors including: total minable pounds and U_3O_8 content of the ore; recovery costs; geographic location; development strategy and the U_3O_8 supply demand situation. The rate and extent of evaluation per prospect is often influenced by the same factors. A few Australian prospects that indicate favorable potential and are in various stages of evaluation include: the Cloncurry, Skal and Anderson Lode, all located 15 to 40 Km to the northeast of the Mary Kathleen deposit in Queensland; the Mt. Painter, Yarramba, and Mt. Victoria located in South Australia's Lake Frome and vicinity; Lake Raeside, Manyingee, Thatchers Soak, Lake Marmion and Mt. Joel, located primarily in the vast calcrete environment of Western Australia; and the Pandanus Creek, Mt. Bundey, the AAEC Prospect, the Barote Prospect and the Beatrice Caramal area are located in the Northern Territory. (See Figure 1 for location of each prospect.)

Olympic Dam Project

The discovery of uranium-bearing sulfide mineralization at the Olympic Dam Prospect in the area of Roxby Downs Station near Andamooka, South Australia is perhaps the most significant mineral evaluation project at this time in Australia. The results of exploration indicate the existence of at least two extremely large ore deposits occuring in brecciated volcanics and granite. The deposits contain up to four percent copper and up to 1.75 pounds of uranium; gold is an important accessory mineral. Evaluation work is continuing with 12 drill rigs. In addition, a 500 meter vertical shaft is being sunk at Olympic Dam to permit detailed evaluation of the mineral zone and to obtain large-volume samples for metallurgical testing. The project is controlled by Western Mining Corp. (51 percent) and British Petroleum Co. Ltd. (49 percent).

Unofficially, ore reserves of the prospect are estimated to be in excess of 300,000,000 tonnes. Contained uranium is approximately 300,000 tonnes U_3O_8. The production of uranium will be associated to copper production, therefore, the supply of uranium from the deposits will be dependent upon the supply demand situation for copper rather than uranium. Plans to develop the deposits are indefinite at this time, pending results of further exploration. The prospect area is classified as a major ore deposit and is designated as number 34 on Figure 1.

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STATISTICAL DATA

EXCHANGE VALUE—$25.00/lb U_3O_8
Determined as of April 30, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of April 30, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
25.70	2.9	11	6

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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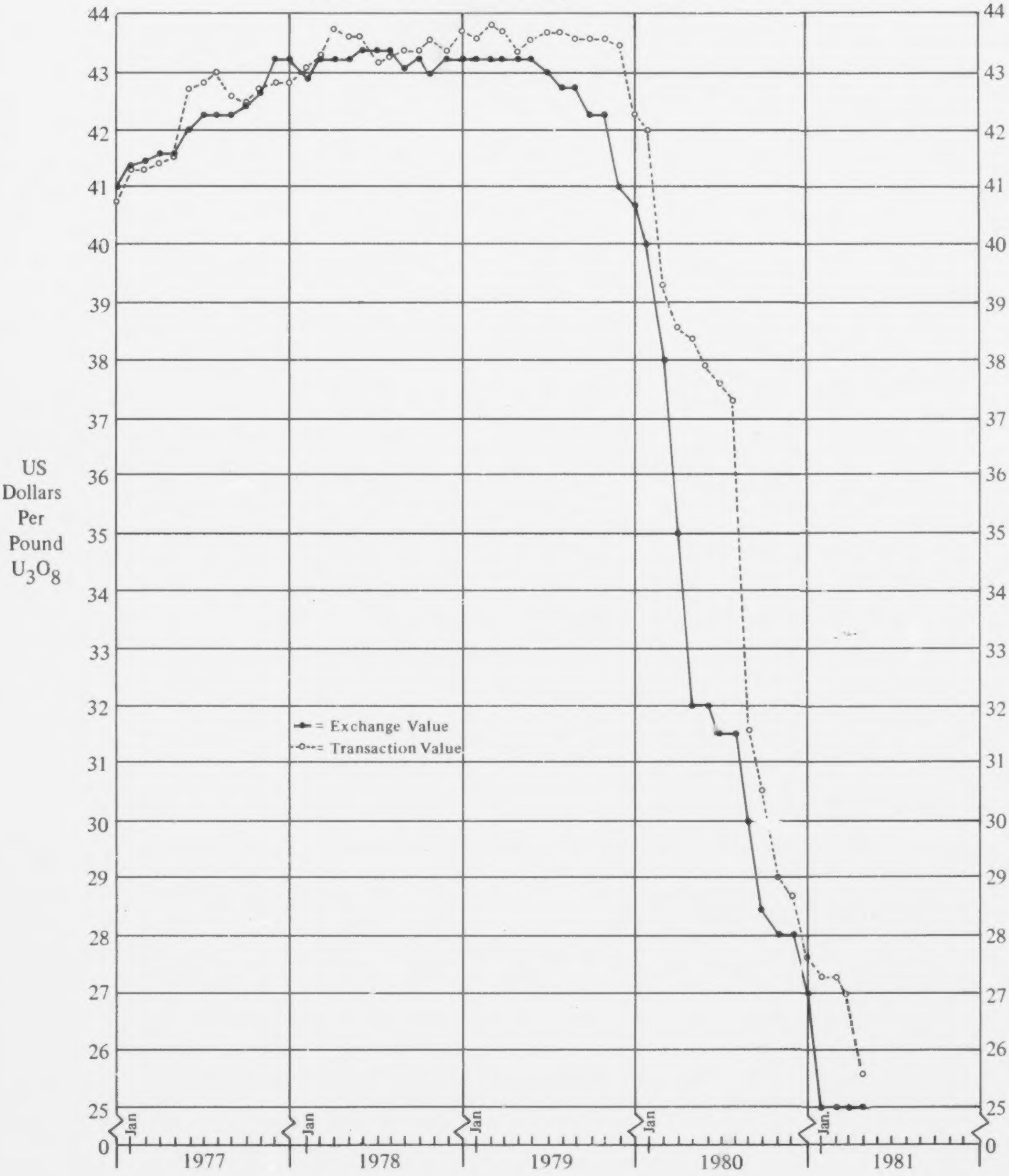
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00								

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70								

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	25.00	55.12	64.99
France (franc)	130.82	288.40	340.09
FRG (mark)	55.15	121.58	143.37
Japan (yen)	5,360	11,817	13,935
Switzerland (franc)	50.38	111.06	130.96
UK (pound)	11.63	25.63	30.22
Australia (dollar)	21.70	47.84	56.41
Canada (dollar)	29.91	65.94	77.75
Niger, Gabon (CFA)	6,541	14,420	17,005
South Africa (rand)	20.36	44.88	52.92

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

LOAN USE CHARGE RATE—7.0%/year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

CONVERSION VALUE—$1.40/lb. U as UF_6

Determined as of April 30, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and/or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1479	82–96	6001–10000	–	Australia	Europe	Price related to market
1486	81–82	301–600	96	US	US	
1487	81	Less than 50	92	US	US	
1489	81–82	101–300	100	US	US	
1497	81–83	601–1000	99	US	US	
1498	81	Less than 50		US	US	Definitive price information unknown
Conversion Transactions						
1491	82–83	601–1000	113	US	US	
1496	81	101–300	96	US	US	

*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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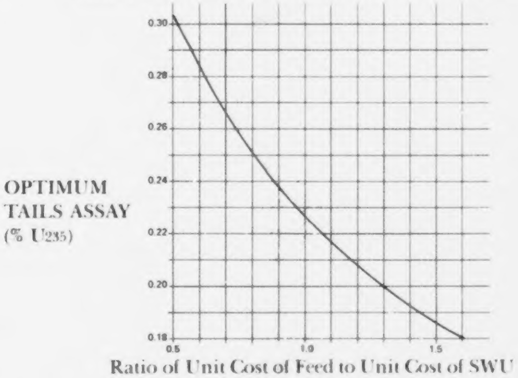
STATISTICAL DATA

OPTIMUM TAILS ASSAY

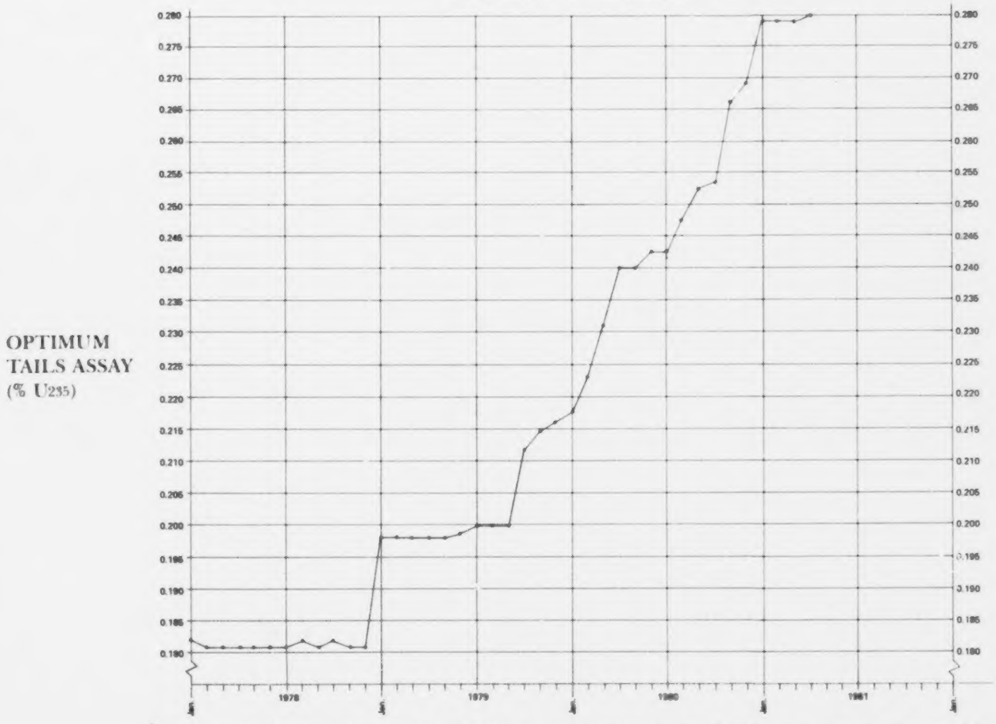
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]		
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)
Annual Avg. 1970(5)	110.0	116.3	91.36	3.88	3.87	3.69
Annual Avg. 1971(5)	114.1	121.3	96.02	4.12	4.15	3.97
Annual Avg. 1972(5)	117.9	125.3	100.00	4.56	4.59	4.26
Annual Avg. 1973(5)	125.9	133.1	105.80	4.84	4.98	4.51
Annual Avg. 1974(5)	153.8	147.7	116.02	5.44	5.63	4.88
Annual Avg. 1975(5)	171.5	161.2	127.15	6.13	6.24	5.39
Annual Avg. 1976(5)	182.4	170.5	133.71	6.76	6.87	5.91
Annual Avg. 1977(6)	195.1	181.5	141.70	7.28	7.67	6.43
Annual Avg. 1978(6)	209.4	195.4	152.05	8.23	8.56	7.02
Annual Avg. 1979(6)	236.5	217.4	165.46	9.27	9.49	7.60
Annual Avg. 1980	–	246.8	177.36	10.26	10.61	8.29
Jan 1980	260.6	233.2	–	9.91	10.06	7.97
Feb 1980	265.9	236.4	–	9.92	10.01	8.01
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05
Apr 1980	271.3	242.5	–	10.00	10.30	8.12
May 1980	271.9	244.9	–	10.18	10.37	8.17
Jun 1980	273.5	247.6	178.93	10.13	10.69	8.24
Jul 1980	276.2	247.8	–	10.24	10.82	8.35
Aug 1980	278.2	249.4	–	10.38	10.78	8.39
Sep 1980	278.8	251.7	182.92	10.54	10.94	8.46
Oct 1980	281.2	253.9	–	10.58	11.00	8.52
Nov 1980	283.4	256.2R	–	10.73	11.06	8.59
Dec 1980	286.1P	258.4	183.98	10.86	11.31	8.68
Jan 1981	289.9P	260.5	–	10.93	11.30	8.72
Feb 1981	294.8P	263.2	–	11.08P	11.35P	8.77P
Mar 1981	298.9P	265.1P	187.30	–	–	8.80P

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Data for 1970-1976, monthly except for the GNP Implicit Price Deflator, and Price Index data for 1977-1978 appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Employment and Earnings data for 1977-1979, monthly, appear on page 33 of Nuexco Report 147.

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AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	215.4	190.04
Annual Avg. 1979	248.8R	196.34
Annual Avg. 1980	321.7P	217.83P
Oct 1979	309.4	201.71
Nov 1979	310.4	201.05
Dec 1979	319.4	201.87R
Jan 1980	340.1	215.74R
Feb 1980	345.6	215.20R
Mar 1980	340.3	214.83R
Apr 1980	327.9	215.14R
May 1980	335.1	214.81R
Jun 1980	338.4	214.14R
Jul 1980	349.1	221.44R
Aug 1980	353.2	219.95R
Sep 1980	351.6	219.45R
Oct 1980	349.5	220.73R
Nov 1980	351.7	221.10
Dec 1980	353.0P	221.43
Jan 1981	359.1P	228.30P
Feb 1981	–	228.12P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.
(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.
(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Annual Avg. 1980	247.0	–	–	–
Nov 1979	228.1	9.97	7.61	7.91
Dec 1979	230.4	9.93	7.51	7.89
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.4R	10.58	8.14	8.65
Sep 1980	252.0	11.00R	8.24	8.71
Oct 1980	255.9R	11.29R	8.28	8.82
Nov 1980	257.6R	11.42R	8.38	8.77
Dec 1980	258.2R	11.43	8.32	8.92
Jan 1981	262.5	11.58P	8.46P	8.90P
Feb 1981	262.6P	–	–	–

P = Preliminary R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)
Annual Avg. 1970(3)	7.34	100.3(4)	
Annual Avg. 1971(3)	7.88	106.4(4)	59.1
Annual Avg. 1972(3)	8.79	113.3(4)	63.9
Annual Avg. 1973(3)	10.51	124.1(4)	72.3
Annual Avg. 1974(3)	13.18	138.5(4)	85.3
Annual Avg. 1975(3)	16.71	157.2(4)	100.0
Annual Avg. 1976(3)	19.30	174.7(4)	115.1
Annual Avg. 1977(3)	23.87	194.4(4)	130.0
Annual Avg. 1978(3)	27.14	137.2	142.7
Annual Avg. 1979(3)	30.18	155.3	164.5
Annual Avg. 1980	35.53	176.7	192.1
Jan 1980	–	165.4	178.3
Feb 1980	–	167.0	180.5
Mar 1980	33.65	168.0	181.7
Apr 1980	–	170.0	184.2
May 1980	–	171.9	187.0
Jun 1980	34.48	174.6	189.0
Jul 1980	–	177.2	192.7
Aug 1980	–	179.2	196.8
Sep 1980	36.19	182.8	199.8
Oct 1980	–	186.3	203.1
Nov 1980	–	187.8	205.6
Dec 1980	37.69	189.9	206.5
Jan 1981	–	191.0	207.2
Feb 1981	–	193.8	209.8
Mar 1981	–	195.2	–

---

(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.

(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."

(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 1.9 of Nuexco Report 140.

(4) April 1970 = 100.00.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1392	400			
1393	60	175	175	Long term
1475	1000			UF_6
1480	300	300	300	
1490	1250			
1550	250	950		
1552	600			
1562			150	Long term
1575		500	500	Long term
1576	250			
1581	100	150	150	Long term
1595	600	600	800	
1600			200	Long term
1610	50			
1627	1000			
1630	500			UF_6
1637	500	500		
1664	100			
TOTALS	7060	3175	3275	
Available for Loan:				
1429	400			UF_6
1602	400			
1668	300			
TOTALS	1100			

*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
Inquiries to Purchase:				
1423	1000	1000		
1459			200	Long term
1462			100	Long term
1514	400			
1529			550	Long term
1587		275	275	Long term
1603		100	100	Long term
1634		400	400	
1640	150			
TOTALS	1550	1775	1625	
Inquiries to Borrow:				
1621	300			
TOTAL	300			

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*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF₆ conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	**Delivery Period* (Thousands of Pounds U as UF6)**			**Remarks**
	0 to 1 Year	**1 to 2 Years**	**2 to 3 Years**	
1451	75			
1584	200	200	200	
1607	850	900	1000	
1609	1000	900	1000	
1619		200	100	
1620	125			
1661		400	400	
TOTALS	2250	2600	2700	

CONVERSION DEMAND

Nuexco Reference Number	**Delivery Period* (Thousands of Pounds U as UF6)**			**Remarks**
	0 to 1 Year	**1 to 2 Years**	**2 to 3 Years**	
1594		400	950	Long term
1608	125	175	175	Long term
1614		300	500	Long term
1622			400	Long term
1626	75			
1665		50	50	Long term
TOTALS	200	925	2075	

***Measured from the date of this Report.**

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 153

The **Exchange Value** remained at $25.00 per pound U_3O_8 for the fourth consecutive month. A few transactions did close below this level, perhaps indicating a softening of the market. However, one large transaction closed at Exchange Value and a much larger percentage of available material continues to be discussed and negotiated at around current Exchange Value.

Active inquiries to sell in the spot and near term market remained at a high level, totaling approximately seven million pounds U_3O_8. Total of inquiries to purchase in the spot and near term market decreased somewhat to 1.5 million pounds U_3O_8. The available near term material is being offered half by primary producers and half by holders of inventory.

The **Transaction Value** declined to $25.70 per pound U_3O_8 from last month's level of $27.00. Transactions from 1981 account for approximately two-thirds of the material used in calculating this month's value. Six uranium transactions are reported this month. Five of the transactions together involved slightly less than two million pounds U_3O_8 for spot and near term delivery. The sixth transaction concerned a resale of Australian material by European equity owners for deliveries over the next fifteen years.

The secondary market for conversion services maintained its high level of activity during April. The **Conversion Value** increased to $1.40 per pound U as UF_6 from last month's level of $1.20. This increase occurred in spite of a tremendous supply overhang in the spot and near term. Two transactions for conversion services in the secondary market closed at around Conversion Value.

European handling of spent fuel, waste storage and reprocessing is summarized in this month's Report. There are two *Topical Essays* this month. One continues the discussion of world demand versus Apparent Future Consumption with a look at the non-US picture. The other presents a study of Japan's nuclear growth and the official optimistic forecast.

Australia's lesser known deposits are summarized and discussed in this month's *Raw Materials* essay.

This Executive Summary may be reproduced for internal distribution.

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JUNE 1981 NUMBER 154

Monthly Report on the Uranium Market

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MONTHLY REPORT ON THE URANIUM MARKET
June 1981 No. 154

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FOREWORD

Beginning with this Report, we will publish an additional US Government index: Gross Average Hourly Earnings of Production or Non-supervisory Workers for Electric and Electronic Equipment (SIC 36). The 1970 to 1979 monthly data for this index is included for reference this month.

There were two typographical errors in last month's Report, Number 153.

United Nuclear Corp.'s (UNC) original interest in the UNC-Homestake Partners operation was incorrectly listed as 40 percent in last month's Report. UNC originally owned 70 percent of the operation.

The Vaal Reefs decrease in profits from uranium in the most recent quarter was incorrectly listed as 19 percent in last month's Report. The South African producer actually reported a 79 percent decrease.

Nuexco President Bob Wolcott delivered a speech at the General Electric 1981 Executive Fuel Conference. A copy of his remarks is included as an insert to the Report.

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URANIUM MARKET

AFRICA

South Africa's uranium resources have been reassessed along the lines of the classification system proposed by the International Atomic Energy Agency. The results of the reclassification are as follows:

Table 1

REPUBLIC OF SOUTH AFRICA
URANIUM RESOURCES AS OF JANUARY 1981
(thousands of metric tons U)

Rock Type	A	B	C	D	E	F	G
Quartz-pebble Conglomerate	206	55	261	81	80	161	422
Tailings	35	9	44	2	5	7	51
Karoo Strata	3	44	47	1	6	7	54
Younger Surficial Sediments	—	1	1	—	—	—	1
Carbonatite	3	—	3	—	—	—	3
TOTAL	247	109	356	84	91	175	531

A: recoverable at a cost of less than US$80/kg U (US$30/lb U_3O_8)
B: recoverable at a cost of US$80—130/kg U (US$30—50/lb U_3O_8)
C: total RAR recoverable at a cost of less than US$130/kg U (US$50/lb U_3O_8)
A, B and C are reasonably assured resources (RAR) (tons U)
D: recoverable at a cost of less than US$80/kg U (US$30/lb U_3O_8)
E: recoverable at a cost of US$80—130/kg U (US$30—50/lb U_3O_8)
F: total EAR recoverable at a cost of less than US$130/kg U (US$50/lb U_3O_8)
G: recoverable at a cost of less than US$130/kg U (US$50/lb U_3O_8)
D, E and F are estimated additional resources (EAR) (tons U)
G is total RAR plus EAR.

It should be noted that the cost categories refer to production costs and not to required selling price. Also, the values are in terms of metric tons uranium metal (U) rather than uranium oxide (U_3O_8). The figures take mining and metallurgical losses into account.

The total amount of uranium resources in the less than US$130 per kg U cost category has increased by only 1,000 tons since the beginning of 1979. Escalating costs are at the root of this minimal change because although the resources have increased, they now come under a cost category greater than US$130 per kg U.

During 1980, the amount spent on uranium exploration in South Africa by 26 mining companies totaled 21.5 million Rand (US$25.4 million). The state itself spent 577,000 Rand (US$680,000) on airborne radiometric and magnetic surveys which covered a total of 67,000 square kilometers. 1980 uranium production figures from 19 plants receiving material from 21 mines showed a 28 percent increase over 1979 production and a 55 percent increase over 1978 production. The 1980 total is 6,146 metric tons U compared to 4,797 metric tons U in 1979 and 3,961 metric tons U in 1978.

The recently released Rio Tinto-Zinc Corp., Ltd. (RTZ) annual report presented a 1980 summary of the Rossing Uranium Ltd. operations, of which RTZ has a 46.5 percent interest. 1980 production of uranium oxide increased to 5,250 short tons U_3O_8 from 4,980 the previous year, in part due to improved efficiency in mining, milling and leaching rates, in addition to enhanced recoveries. Although 1980 costs grew somewhat in comparison to the 1979 number, net profit was significantly higher. 1980 showed a slightly higher sales volume along with higher realized uranium prices.

AUSTRALIA

The contract between Energy Resources of Australia (ERA) and the Swedish utility, OKG, was approved by the Australian Government during May.

The fifth round of safeguards negotiations with Japan will begin next month. Agreement on the text was not reached during the April meeting, although it is expected that the upcoming round of discussion will produce a consensus on the matter. There is reason to believe that the Japanese negotiators will be in no particular hurry to conclude the negotiations in light of Japan's strong uranium supply position and a desire to obtain better terms.

Australia's safeguards agreement with Euratom, initialled at the end of March, is presently going through the various approval stages in Europe and is expected to be finalized without further delay.

Pancontinental Mining Ltd. has announced that its production capacity for the Jabiluka Plant will now be set at 4,500 tons U_3O_8 per year. The original plan was to develop the project in three stages with successive capacities of 3,000 tons, 4,500 tons and finally 9,000 tons per year. The present plan also omits structural and other provisions for an expanded plant beyond the 4,500 tons capacity.

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URANIUM MARKET

The plant at Nabarlek has been producing at design capacity despite the strike of operating personnel, which is now running in its seventh week. The plant has been operating with staff labor. Uranium shipments continue to be hindered, but there are some hopeful signs of resolution in the near future.

The South Australian government has approved the Environmental Impact Statement (EIS) of the Honeymoon project. Approval from the federal government is expected shortly. Following this, construction will begin on the pilot plant. Annual output is anticipated to be 100 tons U_3O_8. It is possible that expansion to a full production level of 430 tons will take place by mid-1982.

CANADA

Negotiations between Consolidated Canadian Faraday and AGIP Nucleare S.p.A. to establish the price of production from the Madawaska mine during the June 1, 1981 to December 31, 1982 period have been completed. The price will be Canadian $32.75 (equivalent to US $27.22). Under the new pricing structure, production from Madawaska should be assured through 1982. Operations are expected to be marginally profitable.

Although Northern Saskatchewan has received the majority of exploration interest during the past few years, work has continued in other parts of Canada. One area of interest is Vaughan Hants County, Nova Scotia where Aquitaine Canada has drilled 115 holes to shallow depths on a uranium prospect. The prospect has geologic similarities to uranium occurrences in the central Massif region of France. The project's location on the eastern seaboard could be a marketing advantage, but extensive additional drilling is needed to determine the level of its commercial viability.

EUROPE

Sweden is now relying primarily on nuclear and hydro power for electricity generation. Figures from the first quarter of 1981 show about 36 percent of electricity production coming from nuclear power. The exact percentage from nuclear power will vary with the season and the availability of hydro power. The nuclear percentage is expected to range from 35 to 40 percent over the next few years.

There are a small number of oil fired cogeneration facilities producing electric power in Sweden and peak power is provided at times from oil fired units. Discussions on possible construction of coal fired units are continuing but no such project is under way as yet.

Uranium exploration and mining projects in Portugal will now be open to private sector participation. This shift from a state-monopolized industry will allow private companies to invest up to 49 percent in a mining joint venture with the state-owned National Uranium Company (EUN), as well as allow them to pursue projects on their own.

Portugal's uranium production plans include a four-fold increase over the current annual level of 120 tons by 1985. The country's reasonably assured resources are approximately 9,000 tons U_3O_8.

There have been announcements over the past few months of several European nuclear reactors having reached full power operation. On March 30, 1981, the Spanish 930 MWe Pressurized Water Reactor (PWR) Almaraz nuclear plant achieved its first criticality. The plant's output was first connected to the Spanish grid on April 29. The Italian 840 MWe, Boiling Water Reactor (BWR) Caorso plant reached its first commercial full power operation on March 30, 1981.

The USSR's Leningrad station reported that its fourth 1,000 MWe unit reached full power and was placed on the grid on February 9, 1981. With 4,000 MWe power generation capability, the Leningrad station is now the largest in the USSR. The first three 1,000 MWe units were placed into full power operation on December 1, 1974, December 1, 1975 and June 28, 1980, respectively.

FAR EAST

Recently released data indicates the extent of Japan's diverse uranium supply. Nearly 384 million pounds U_3O_8 have either been delivered or are to be delivered under contracts extending as far into the future as 2003. The country by country breakdown is shown in Table 2 as of December 31, 1980.

The total of 383.9 million pounds under contract as of the end of 1980 represents an increase of some 32 million pounds U_3O_8 from year end 1979. Australia

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URANIUM MARKET

Table 2
URANIUM SUPPLY COMMITMENTS TO JAPAN

Supplier Country	Millions of Pounds U_3O_8	Percent of Total Supply	Last Delivery Year of Longest Term Contract
Canada	121.7	31.7	2003
England	87.0	22.7	1996
South Africa	58.5	15.2	1994
France	23.0	6.0	1986
Australia	37.4	9.7	1996
US	16.0	4.2	1991
Niger	40.3	10.5	1996
TOTAL	383.9	100.0%	

and Canada account for this additional material by supplying 21 million pounds and eight million pounds respectively.

The material designated as England-supplied is primarily from Rio Tinto-Zinc Corp. Ltd. (RTZ). The sources of this supply are Australia, Canada and Namibia. In the case of France the countries of origin include, in addition to France, Niger, Gabon and perhaps Canada and South Africa.

These data reveal several interesting points. South Africa's 15 percent share of Japan's supply is approximately equal to South Africa's traditional 16 percent share of world uranium production. Although Australia is presently shown representing only ten percent of Japan's total supply, it is expected that this share will increase in the future in view of the historic raw materials trade between these two countries. Finally the US, despite being the world's largest uranium producer, has had only a small share of the Japanese market.

UNITED STATES

Legislation reducing the amount of uranium severance tax in New Mexico was passed by that state's legislature a few months ago. The bill which passed was a modified version of an original one which called for a reduction of the tax by basing it on only 25 percent of sales price. The final form of the bill imposes a severance tax on 60 percent of sales price and has a three year sunset clause. Thus the schedule of uranium severance taxes passed in New Mexico in early 1980 has in effect been reduced by 40 percent.

On May 6, 1981, the US Department of Energy (USDOE) published increases in the price of separative work, as follows:

1. *Requirements-type Contracts:* Effective 180 days after publication, the price for separative work under Requirements-type contracts will be $141.15 per SWU, or the ceiling charge, whichever is less.
2. *Fixed-Commitment Contracts:* Effective October 1, 1981, price for separative work under all Fixed-Commitment contracts will be $130.75 per SWU.

The USDOE has released figures which show nuclear energy ahead of oil in electricity generation for 1980. The 251.1 billion kilowatt hours of electricity (11 percent of all power generated) produced by nuclear power, barely edged oil's contribution of 246 billion kilowatt-hours (10.8 percent of US electricity). This represents the first time in US history that nuclear power has led oil in electricity generation. Although nuclear production declined 1.6 percent from 1979 figures, oil generation fell approximately 19 percent. A 1.7 percent increase was seen in overall electrical generation.

Now that the entire Westinghouse affair appears to be reaching an end, the market implications of the litigation and settlements can be examined. Following are some conclusions on how the Westinghouse situation will effect uranium supply, demand and price.

Table 3 summarizes Nuexco's estimate of the uranium involved in the utility settlements with Westinghouse. The original court-ordered allocations are included in the totals. In three of the settlements (Duquesne Lighting Co., Southern Ser-

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vices Co., and the Tennessee Valley Authority), there was no additional uranium involved other than the original allocations. Table 4 summarizes Westinghouse's total annual delivery obligations under the settlements.

As a result of the settlements, Westinghouse is now in a position to fill all of its litigated uranium supply commitments. Table 5 shows the latest Nuexco estimate of Westinghouse's cumulative supply-demand balance. Westinghouse commitments to deliver uranium to the former utility litigants total 30.2 million pounds U_3O_8 between 1981 and 1999. Inventory, material already under contract and supplies from settlements of Westinghouse suits against producers will yield a total of 25.8 million pounds during the period. The balance of 4.4 million pounds U_3O_8 remains to be filled, either by additional purchases, or by Westinghouse production from Wyoming Mineral Corp. That obligation would be reduced to 3.4 million pounds if Long Island Lighting Co. does not exercise its option to purchase. This material balance concerns only the utility contracts formerly under litigation, and not any other supply commitments Westinghouse may have. However it would appear that Westinghouse has brought its uranium supply position to the point where it should not have a significant influence on the market.

Table 3

ESTIMATED QUANTITIES OF URANIUM INVOLVED IN WESTINGHOUSE SETTLEMENTS

(thousands of pounds U_3O_8)

Utility	Quantity Originally in Dispute[1]	Settlement Quantity[1] [2]
Consolidated Edison Co.	2,500	2,200
Duquesne Lighting (Capco)	700	100[3]
Florida Power & Light Co.	3,600	1,700
Kansas Gas & Electric Co.	4,000	2,400
Long Island Lighting Co.	9,000	2,600[4]
Northeast Utilities	2,700	2,000
South Carolina Electric & Gas Co.	1,000	2,400
South Texas Project	10,500	8,700
Southern Services Co.	800	100[3]
Sweden: Sydkraft		
SSPB	5,000	3,800
OKG		
Tennessee Valley Authority	3,600	600[3]
Texas Utilities	2,900	1,200
Union Electric Corp.	10,200	6,200
Virginia Electric & Power Co.	13,800	9,900
Wisconsin Electric Power Co.	2,600	1,900
TOTAL	75,900	45,800[5]

[1] Quantities are rounded to nearest 100,000 pound.

[2] Including original court-ordered allocation.

[3] No uranium other than original court-ordered allocation was included in the settlement.

[4] Includes an option for one million pounds on the part of Long Island Lighting Co.

[5] Difference between this total and that of Table 4 is due to rounding.

Table 4

ESTIMATED TOTAL ANNUAL DELIVERIES UNDER WESTINGHOUSE SETTLEMENTS

(thousands of pounds U_3O_8)

Year	Quantity	Year	Quantity
1976	5,000	1986	2,600
1977	2,300	1987	2,600
1978	2,200	1988	2,600
1979	2,300	1989	2,400
1980	3,600	1990	1,900
1981	2,000	1991	2,000
1982	2,100	1992	1,500
1983	1,500	1993	1,200
1984	1,800	1994	1,200
1985	2,100	1995-99	2,300
		TOTAL	45,200

Table 5

NUEXCO ESTIMATE OF WESTINGHOUSE CUMULATIVE SUPPLY-DEMAND BALANCE

(1981-1999)

(millions of pounds U_3O_8)

Total Delivery Commitments	
Including Settlements	30.2
Available Supplies	
(other than future production)	
Inventory	1.7
Purchases	1.6
Gulf Settlement	13.0
Foreign Producer Group Settlement	9.0
Other	0.5
	25.8
Unfilled Commitments	4.4

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URANIUM MARKET

TRANSACTIONS

There are three uranium transactions reported this month. One is a spot sale of between 50 and 100 thousand pounds U_3O_8 equivalent as UF_6 from a US producer to a US utility. A small spot sale of less than 50 thousand pounds U_3O_8 was made from a US producer to a European utility. A larger transaction of between 300 and 600 thousand pounds U_3O_8 took place between a US utility and a European utility. The delivery period is 1982.

One secondary market conversion transaction is reported this month. It involves the conversion of between 50 and 100 thousand pounds U.

PRICING

The **Exchange Value** as of May 31, 1981 is $25.00 per pound U_3O_8, unchanged from the four previous months. The major factors considered in the determination of this month's Exchange Value were:

1. Two near term transactions closed at the $25.00 level involving a total of about 500,000 pounds U_3O_8 or its equivalent.

2. Sellers are responding at about the $25.00 level to open requests for material and are countering at this level to bids made at under Exchange Value.

3. Some active US sellers have withdrawn their material from the market in order to respond to a non-US inquiry. Due to the validity conditions of these offers, the material is no longer available for sale to other parties.

4. US producers looking for available material are renewing their contacts with inventory holders. Earlier, such inquiries preceded the announcement of shutdowns, as well as increased demand for replacement U_3O_8.

Material available for near term delivery as presented in the *Market Opportunities* section totals 7.7 million pounds U_3O_8 or its equivalent. Over one fourth of the available material is in the form of UF_6 which must be either swapped or deconverted in order to respond to requests for U_3O_8. Inquiries to purchase U_3O_8 total 1.75 million pounds for the same period.

The **Transaction Value** remained at $25.70 per pound U_3O_8 for the second consecutive month. Qualifying transactions numbered 12 and involved 2.9 million pounds U_3O_8 sold over the last seven months.

CONVERSION

The **Conversion Value** declined 25 cents to $1.15 per pound U as UF_6. This decrease in the spot and near term market price for conversion services, following an increase in the previous month, demonstrates the volatility of a thin market, particularly as one side of the market clears.

A number of inventory holders unable to sell UF_6 are attempting to deconvert their material so they may sell it as U_3O_8. However, the needs of most buyers desiring conversion services for spot or near term delivery have recently been covered and the lack of new buyer interest has exerted downward pressure on the price. U_3O_8 inventory holders may emerge as buyers in this secondary market if the price becomes such that it argues for storage of material in a more advanced form.

In addition, the primary converters have been more aggressive in the terms and conditions they are offering, particularly in the longer term, responding to secondary market competition. Because price differential is the main reason for buyers to look to the secondary market, the secondary market price is under pressure from the activities of the primary converters.

One transaction for conversion services in the secondary market is reported this month involving between 51 and 100 thousand pounds U of conversion for immediate delivery. The price is higher than current Conversion Value.

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TOPICAL ESSAY

WORLD DEMAND: PART III, OBSERVATIONS

In Reports 151 and 153 Nuexco presented breakdowns of its estimate of US and non-US demand. The methodology used to develop these demand figures was briefly explained, and the difference between demand and Nuexco's Apparent Future Consumption (AFC) was clarified. In this essay the two previous commentaries are combined to provide a worldwide picture, and some general conclusions are drawn.

To review, AFC is Nuexco's computation of the amount of U_3O_8 which would be required to fabricate fuel for loading and reloading reactors. It is compiled and computed on a reactor by reactor basis, with AFC for each reactor being based on specific core characteristics, 0.25 percent tails assay, no recycling, 24 month lead times for first core procurement and 18 month lead times for reload procurement. Reloads are assumed to occur one year after the commercial operating date and annually thereafter except in cases where alternate schedules are known to be used by individual utilities. Nuexco estimates of individual capacity factors are used.

Demand, of which AFC is a significant component, includes the intangible market perceptions of each utility. Factors such as price, security of supply, political actions and inventory situations influence each buyer's view of the market. Each utility has quantified these perceptions into a set of demand figures, and Nuexco has compiled these utility numbers into an aggregate form.

Tables 6 through 9 show Nuexco's estimate of Utility Demand, Utility Demand Less AFC, Unfilled Demand, and Unsold Production for the World (Outside Communist Areas). Theoretically, total demand will always be greater than or equal to AFC. The further out the estimate is made, the larger the difference between demand and AFC is likely to be. Conversely, the demand estimate will approximate AFC as the length of time forecast becomes shorter.

Thus, in Table 7 the annual difference between demand and AFC is steadily increasing over time. This reflects the fact that as utilities are forced to forecast their demand farther into the future, their demand estimates become increasingly conservative relative to the actual requirements of the reactor. However, the difference between demand and AFC is not uniformly increasing over time, and it is here that reality differs from theory. In actuality, utilities do not purchase along AFC lines but along anticipated demand lines, and this is further skewed by official reactor schedule changes, cancellations, and supply shifts. Consequently, there are many situations in which demand has in effect appeared and been filled one or more years before AFC shows it.

It is even possible that, for a given utility in a given year, AFC will exceed demand. An example of this would be a utility which had originally planned to have a reactor come on line in 1980, and therefore purchased uranium for the first core in 1978, but subsequently slipped the commercial operation date to 1984. In this case the first core AFC would appear in 1982, but there would be no demand component, as this demand had already been filled. Thus the 1982 AFC figure would probably be higher than the 1982 demand figure. It is for this reason that Table 7 has a *non*-uniformly increasing difference.

Table 8 goes on to show World Utility Unfilled Demand, which may be compared against Table 9, World Unsold Production. As can be seen, the cumulative unsold production through 1990 exceeds the cumulative unfilled demand. In assessing the world unsold production, Nuexco has done so on a mill by mill basis. Some of the largest planned uranium operations have been assumed to be cancelled or deferred and their output is not in the unsold production category. Despite this relatively low production estimate, on a cumulative basis unsold production still exceeds the utilities unfilled demand, which must be considered to be a high case of actual utility needs. Thus it would appear that upward pressure on real uranium prices would not be expected for some time.

The above conclusion assumes that free market economics apply. Specifically, it assumes the nonoccurrence of a US uranium embargo, of an interruption in supply due to political reasons or of any effective government price controls in major exporting countries. It is in these areas that uncertainty remains, and if there is to be any marked change in price, it is likely to come as a result of these activities.

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TOPICAL ESSAY

Table 6

WORLD UTILITY DEMAND
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	8.0	12.4	13.7	16.2	18.2	21.0	20.9	22.3	22.1	22.5
Europe	32.3	39.5	39.6	44.9	42.8	46.8	51.2	48.0	49.1	49.0
Other WOCA	4.0	5.3	6.5	6.3	7.0	7.4	8.7	8.6	7.9	9.1
US	36.6	37.3	42.4	48.3	52.9	55.9	55.9	56.9	57.5	57.3
World Total:	80.9	94.5	102.2	115.7	120.9	131.1	136.7	135.8	136.6	137.9
Cumulative:	81	175	278	393	514	645	782	918	1,054	1,192

Table 7

WORLD UTILITY DEMAND LESS AFC
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	1.1	5.5	6.9	5.1	6.5	9.4	10.2	12.7	13.6	13.8
Europe	6.7	10.6	4.2	14.1	6.5	8.8	6.3	5.6	5.8	6.3
Other WOCA	0.9	0.2	0.6	1.2	2.4	1.5	1.2	1.6	2.3	3.0
US	15.7	14.4	15.3	17.9	20.1	20.4	20.8	19.3	17.1	17.0
World Total:	24.4	30.7	27.0	38.3	35.5	40.1	38.5	39.3	38.8	40.
Cumulative:	24	55	82	120	156	196	235	274	313	353

Table 8

WORLD UTILITY UNFILLED DEMAND
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Far East	0.0	0.1	0.1	0.1	0.3	1.8	1.3	4.3	3.4	6.4
Europe	1.5	1.7	3.3	3.7	3.9	5.5	5.7	6.9	8.4	7.4
Other WOCA	0.4	0.7	1.8	1.6	2.3	1.6	1.9	2.6	1.9	2.2
US	0.3	1.5	4.4	6.4	12.3	14.9	23.8	28.9	33.6	36.3
World Total:	2.2	4.0	9.6	11.8	18.8	23.8	32.7	42.7	47.3	52.3.
Cumulative:	2	6	16	28	46	70	103	146	193	245

Table 9

WORLD UNSOLD PRODUCTION
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Annual:	16.8	16.8	17.5	22.4	25.1	32.9	35.8	37.3	40.2	39.6
Cumulative:	17	34	51	74	99	132	167	205	245	284

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COMMENTARY

The Evolving Uranium Market

Today's uranium market is markedly different from that of just two years ago. This section will enumerate some of those changes and touch on the reasons for their occurrence. Of course, the most important change is price. That of the Exchange Value published on May 31, 1979 was the last one to attain the all-time high level of $43.25; two years later, Exchange Value has declined by 40 percent. If inflation is taken into account, today's Exchange Value is less than half that of two years ago. The most important reasons for the decline are outlined below:

1. Forecasts of installed nuclear electric generating capacity have been reduced repeatedly, as have the associated forecasts of reactor uranium requirements. The accident at Three Mile Island (TMI) is largely responsible for stimulating worldwide reassessments of nuclear power. As a result of those reassessments, numerous reactor plants have been cancelled, deferred or delayed.

2. Rising prices for electrical energy have depressed demand. Projections of high growth rates for electric demand have given way to substantially lower projections. In the US, expected growth rates have dropped from seven percent per annum a few years ago to approximately two percent per annum. Even though regional exceptions may exist, the average US surplus of generating capacity has increased more than 30 percent.

3. Reaction to the accident at Three Mile Island led to a US moratorium on licensing of power reactors. That moratorium and the additional safety retrofits imposed in response to TMI set back the US nuclear industry by more than two years, even though the moratorium itself lasted less than half that time. Over the past two years, the number of new US nuclear power plants estimated to begin commercial operation has changed drastically. Before TMI, Nuexco estimated that 61 plants would begin commercial operation in the US during the period 1979 through 1984. Six months after TMI, the number had dropped to 50. Last November Nuexco estimated that 21 plants would start up during that time period. Today, in light of recent US NRC statements there are only 17 in that category.

4. Changes in the US Nuclear Regulatory Commission (NRC) licensing procedures have led forecasters to adopt more pessimistic attitudes toward the future rate of additions to US nuclear electric generating capacity. The USNRC itself has come to be widely recognized as an obstacle to the licensing of power reactors.

5. The general financial health of US utilities has worsened and awareness of this problem has increased. Double-digit inflation, soaring interest rates, construction cost overruns, construction delays and licensing delays have combined to increase dramatically the difficulty of financing the construction of power reactors. Record amounts of money must now be financed for longer periods of time at higher interest rates. Under these conditions, it is doubtful that any US utility would seriously consider ordering a new nuclear plant.

6. Utilities find it more and more difficult to fund construction, especially that of power reactors. Consumers find it increasingly difficult to pay in advance for benefits which may or may not be realized at some indeterminate future time. Rate-making bodies, being essentially political animals, respond much more to the near term desire to keep rates down than to the prospect of running short of electricity after their terms of office expire.

7. Adherents of the so-called soft energy paths advocate an energy strategy based on wind, tides, geothermal steam, biomass fuel, solar energy and conservation. Despite the lack of sufficient technical or economic development, the advocates of such a strategy give short-sighted regulators a convenient excuse for ignoring the realities of their energy future.

8. Ever since the advent of commercial nuclear power, uranium production has exceeded consumption. The past two years have seen the widespread recognition of the degree of this imbalance. This recognition has depressed near-term demand for uranium.

9. Utilities have begun selling some of their large uranium inventories. This added selling pressure has exacerbated the market imbalance created by high inventories, low demand and overproduction.

10. As uranium prices have dropped, the economics of uranium production have changed quite rapidly. US producers having high production costs have entered the market to buy material rather than produce it.

11. Several US producers have cut back, suspended or terminated all or portions of their uranium

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production operations in response to expectations of a prolonged price depression.

Thus the uranium industry has quickly reached a condition of depression not seen since the early 1970's. It would be interesting to compare the state of the industry today with the earlier depression. The Exchange Value has remained at $25 for 5 months. Many have asked if this is a signal that the market has bottomed out. The US market price bottomed at about $6 per pound in 1972. Using the Implicit Gross National Product (GNP) deflator as an inflation index, $6 in 1972 is roughly equivalent to $11.22 today. (The most recent index is 187.30, compared to the 1972 annual average of 100.0)

To get a true comparison of relative economics, it is necessary to include changes in cost due to factors other than inflation. The grade of ore is generally the most sensitive variable in cost of production in the mining industry. If the 1972 price is further adjusted to the change in grade between 1972 and today, a more accurate comparison can be made between today's Exchange Value and the price reached at the bottom of the previous depression. US average ore grade in 1972 was 0.21 percent U_3O_8 versus 0.12 percent in 1980.

Thus the $6 price in 1972 could be roughly equated to a price of about $20 today. ($6 x 187.3/100 x 0.21/0.12) However, there have been additional cost increases since 1972 occasioned by health, safety and environmental legislation, and increased severance taxes. General industry opinion is that these increased costs have amounted to on the order of five dollars per pound in the US.

In conclusion it could be argued that today's spot market price is economically equivalent to the price at which the previous depression bottomed out. This does not necessarily indicate the market has bottomed out; only that any further significant decline might lead to a more seriously depressed market than that of the early 1970's.

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GREAT DIVIDE BASIN, WYOMING

The newest uranium production center in the US is located in the Red Desert area of the Great Divide Basin, Wyoming. Union Oil Co. of California began production operations at its Sweetwater Uranium Project in October 1980. Production was interrupted by a fire in the mill in late October and was not resumed until February of this year. Since then, it has been demonstrated that the production facility is capable of operating at design capacity of 3000 tons ore per day. Figures 1 and 2 are aerial photographs of the open pit mine and mill of Union Oil's Sweetwater Uranium Project. Tailings will be deposited in the large holding area at the top of each figure.

Union Oil is one of about 30 to 35 companies which was attracted to the Great Divide Basin for uranium exploration during the early 1970's. The renewed potential for discovering uranium in basin Tertiary rocks followed discoveries in Tertiary formations of the mountainous areas to the north and northeast of the basin (Crooks Gap and Green Mountains area). Subsequent exploration in the Red Desert led to a number of uranium discoveries associated with many miles of identifiable roll-front geology.

It appeared by the mid 1970's that the new district would become a major production center. However the fluctuation of the uranium concentrate market has resulted in postponements and or cancellations of a number of scheduled production projects. The Union Oil project may be the only conventional mine and mill complex to achieve production in the district prior to the emergence of more favorable market conditions. Another factor which undoubtedly led to the postponement of certain projects is the characteristically low-grade nature of mineralization in the basin area. Overall, the average uranium content of ore is about one pound U_3O_8 per ton, although there are a few isolated high-grade zones containing limited tonnage.

District Geology

The Great Divide Basin is a structural depression encompassing over 3500 square miles in Sweetwater and Fremont Counties of central Wyoming. The entire basin area is confined within a segment of mountainous topography along the Continental Divide. This unusual topographic feature was created by a divergence of the Continental Divide at the northwest and southeast limits of the basin and caused the area to become captive to internal drainage, erosion and redeposition.

Geologically, the Great Divide Basin consists of a number of internal basins. The Red Desert is by far the largest single depression, occupying almost the entire central and eastern portion of the basin area. It is presently considered to be the most important area for the occurrence of uranium; however, important deposits occur in Bison Basin as well. Discoveries outside the Red Desert and Bison Basin areas have been small and of limited potential for commercial development.

Geologic development of the basin began during Late Cretaceous and continued through much of early Eocene time. Essentially all exposed rocks within the basin consist of lacustrine and fluviatile sediments of Tertiary age. The basin is surrounded by older rocks positioned along the Continental Divide during the period of uplifting and faulting. The source of most Tertiary sediments was from the north and northeast. Rocks of Precambrian through Cenozoic age were highly faulted and folded to make up Crooks Mountain and the Green Mountains immediately adjacent to the basin area and the Granite Mountains further to the north.

The oldest Tertiary formation present in the basin is the Fort Union Formation which is deposited unconformably on the Lance Formation of Late Cretaceous age. The Fort Union consists mostly of lacustrine shale, siltstone and thin sandstone associated locally with impure coal beds. The source of arkosic sandstones and conglomerates distributed throughout the northern portion of the Fort Union deposition was probably the Granite Mountains. The age of the Fort Union Formation is Paleocene.

The Fort Union Formation is overlain by sediments of Eocene age which make up about 1000 feet of basin fill. The western and southern portions of the basin are covered by the Wasatch group which includes the Green River and Bridger Formations. The Wasatch group consists of sandstone, siltstone, limestone, conglomerates, oil shale and coal beds. To the north and northeast, the Wasatch group rapidly grades into and intertongues with the equally thick, medium to very coarse grained arkosic sandstones and conglomerates of the Battle Spring Formation. The entire formation consists of fluvial stream deposition.

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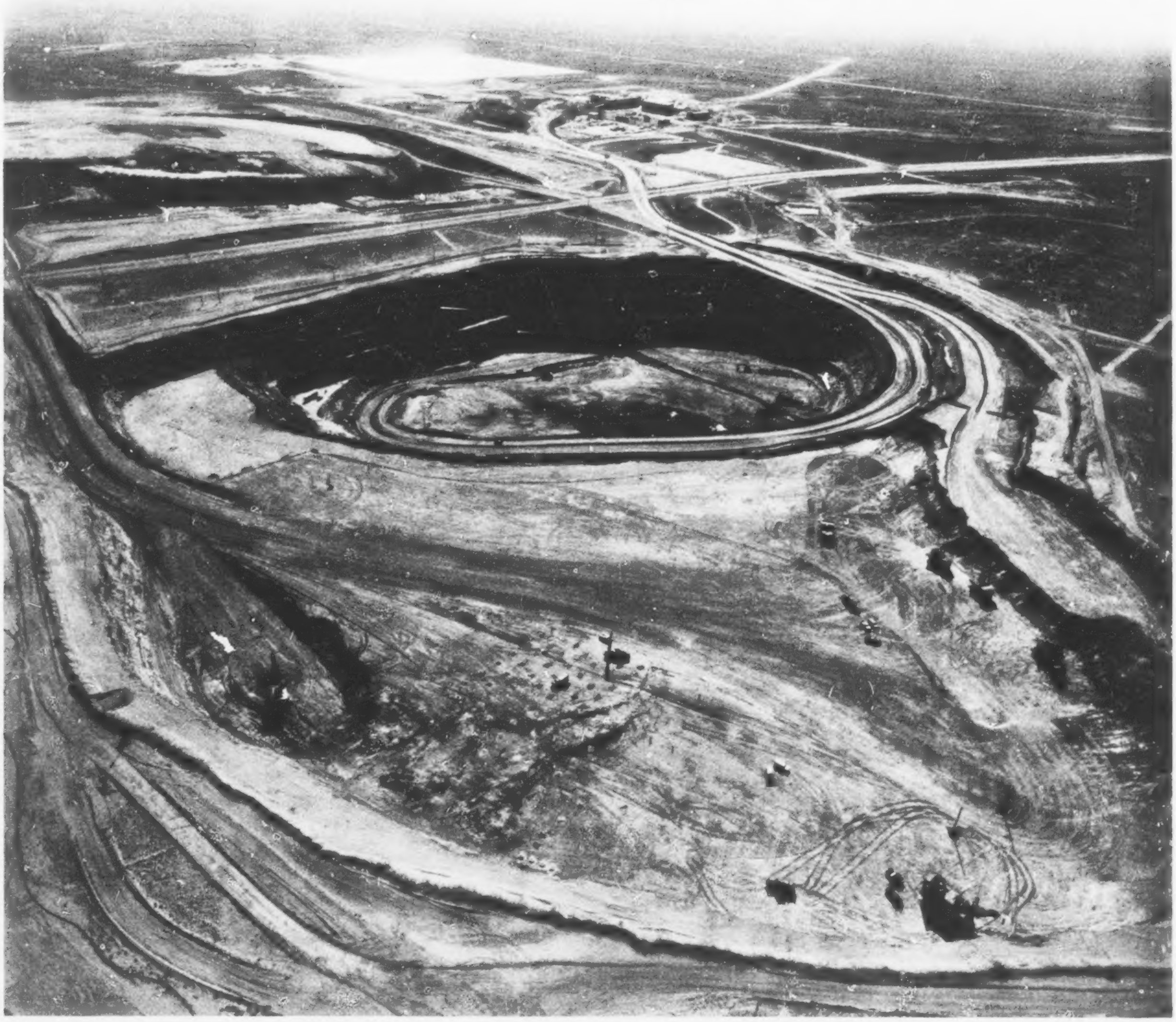

Figure 1
AERIAL VIEW OF THE OPEN-PIT MINE AT UNION OIL'S SWEETWATER URANIUM PROJECT, RED DESERT AREA, WYOMING

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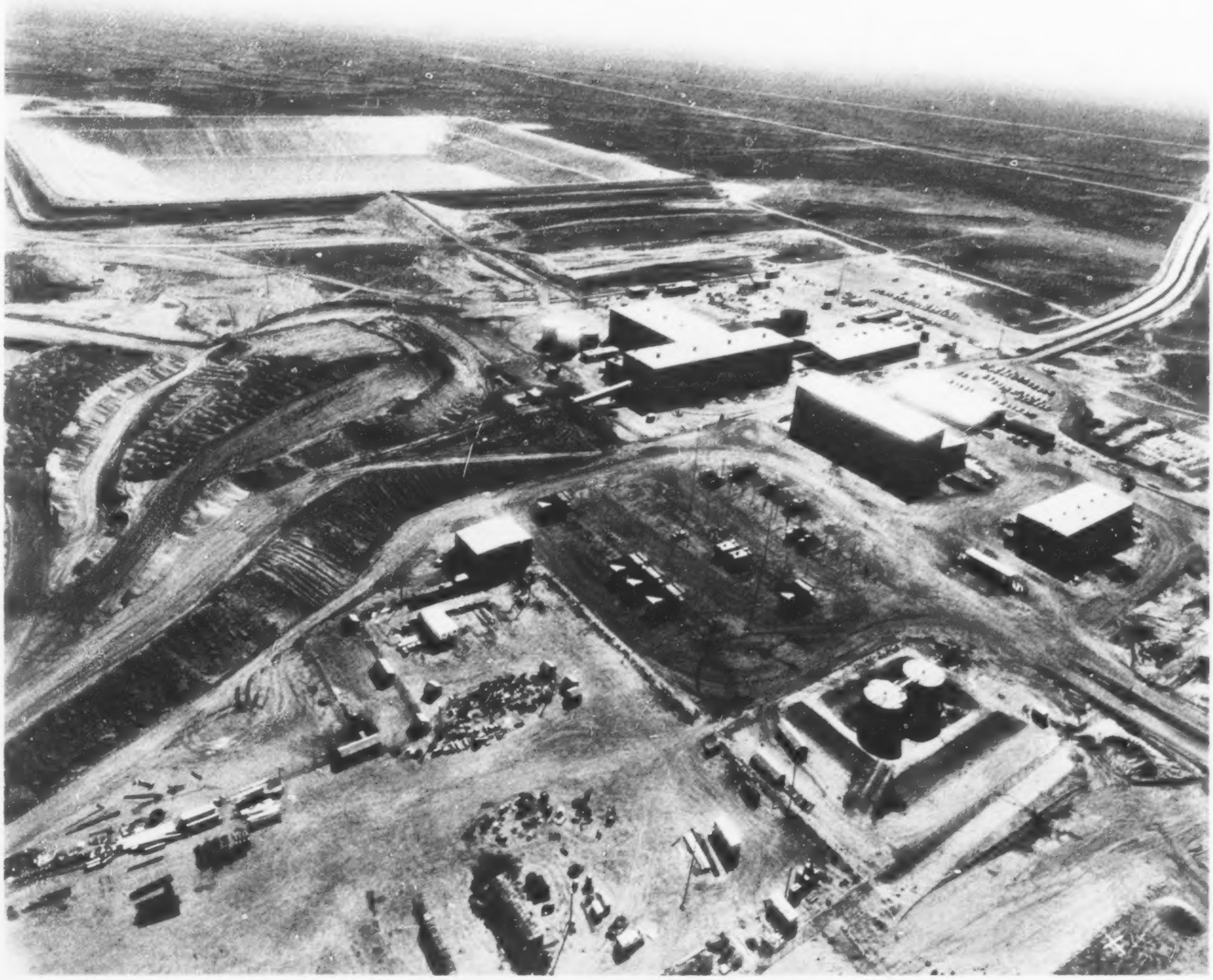

Figure 2
AERIAL VIEW OF THE MILL AND TAILINGS DISPOSAL AREA AT UNION OIL'S SWEETWATER URANIUM PROJECT, RED DESERT AREA, WYOMING. ORE STOCKPILE IS AT LEFT.

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RAW MATERIALS

The general nature of the make up and mode of occurrence of the Battle Spring Formation indicates that its source was predominantly from the Granite Mountains to the north. During the late Paleocene and throughout the early Eocene times, extremely large quantities of debris were eroded from the Granite Mountains to form a vast coalescing alluvial fan complex which spread southward into the basin. Additional coarse material was deposited basinward during the period of uplifting of Crooks Mountain and the Green Mountains. The poorly sorted material making up the formation contains detrital coal and carbonaceous trash which combines to make the formation a suitable host for uranium deposits. The major uranium deposits of the basin are confined to the Battle Spring Formation.

Uranium Deposits

Uranium was first discovered in the Great Divide Basin in 1936. Schroeckingerite, a hydrated fluo-carbonate-sulfate of sodium, calcium and uranium was discovered at Lost Creek in the Red Desert. Although the occurrence is considered to be the largest known deposit of schroeckingerite in the world, it represents a limited quantity of low-grade uraniferous material. The existence of the mineralization drew attention to the basin area and resulted in prospecting during the mid-1940's. Anomalous radioactivity was subsequently discovered in coal beds located in the central basin area about 1945.

Prospecting throughout the region gained momentum in the early 1950's following important discoveries in the Gas Hills district. The prospecting spread rapidly into the Crooks Mountain, Green Mountains and Red Desert areas after commercial uranium deposits were found in the Crooks Gap district in 1954. By the end of 1972, about 6.8 million feet of drilling had been completed in the Red Desert area. Interest in the area increased again as a result of exploration success during the early 1970's. Through the end of 1980, exploration and development drilling exceeded 18 million feet in the Red Desert and Bison Basin areas.

At least 28 important low-grade uranium deposits have been discovered in the basin area, mostly in the Red Desert. In addition, numerous occurrences of mineralization have been discovered but have not yet been fully delineated. The mineralization is almost always associated with poorly-sorted, arkosic sediments of the Battle Spring Formation. The ore occurs in C-shaped and tabular deposits, both associated with typical roll-front geology as related to multiple alteration frontal systems that extend basinward in extremely sinuous patterns. The ore deposits may occur in at least four sandstone horizons as is the case at Union Oil's Sweetwater project.

The greatest amount of ore is found in a single sandstone unit about 150 feet thick. The remaining ore-bearing sandstone units vary from about five to 50 feet in thickness. A large number of the basin ore deposits are within 200 to 400 feet of the surface and are suitable for open pit or solution mining. Nuexco roughly estimates low-grade reserves for the basin area to be about 100 million pounds U_3O_8. Figure 3 shows the approximate location of the ore deposits and roll-front trends with relation to area geology. However, five of the ore deposits shown on the map are actually within the Crooks Gap district; reserves of these five deposits exceed 150 million pounds U_3O_8. Table 10 identifies ownership of the various ore deposits shown on the map.

Table 10

OWNERSHIP OF URANIUM DEPOSITS IN THE CENTRAL AND NORTHEAST PORTIONS OF THE GREAT DIVIDE BASIN, WYOMING

Crooks Gap District	Red Desert and Bison Basin Districts
1. Western Nuclear, Inc.	4. Texasgulf, Inc.
2. Pathfinder Mines Corp. (Big Eagle Mine)	5. Kerr McGee Corp.
3. The Anaconda Co. Pioneer Nuclear, Inc. Texas Eastern Nuclear, Inc.	6. Pioneer Nuclear Texas Eastern
	7. Teton Nedco
	8. Union Carbide Corp.
	9. Union Oil
	10. Ogle Petroleum
	11. Rocky Mountain Energy Co.
	12. Conoco, Inc.

Uranium Source

The source of uranium in the Red Desert area was probably the uranium-rich granites from the Granite Mountains and the volcanic tuffs that covered most of the region from about middle Eocene time. Uranium was taken into solution as the groundwater moved through the uranium-bearing formations. It precipitated-out in the favorable environment of the Battle Spring Formation. The main ore mineral

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present in the district is uraninite. Coffinite has been identified as an accessory mineral in several different ore deposits.

Formation porosity and permeability is important to the stability of ore zones. The coarse-grained and coalescing nature of the Battle Spring Formation created a hydrologic environment conducive to rapid discharge and recharge of mineral-bearing solutions. The rapid movement of solutions through the formation dispersed the uranium among the thick sandstone units as well as among the coal and shale beds. The result was a wide distribution of low-grade uranium mineralization scattered throughout the district.

Such conditions have also been a factor in establishing a disequilibrium between uranium and its daughter products, a condition which is apparent in certain areas. Disequilibrium is rather common in mineralization situated above the present water table or within an oxidized ore zone. The radiometric values in a disequilibrium are often noticeably higher than the actual value of contained U_3O_8. The reverse of this is true in certain circumstances with ore below the water table, or in that portion of an oxidized zone situated on the permanent water table; the chemical values are higher than the radiometric values. This type of "enrichment" tends to support the theory that down-dip migration of uranium has taken place. One may expect to discover "high-grade" mineralization by exploring the uranium-bearing formation to greater depths.

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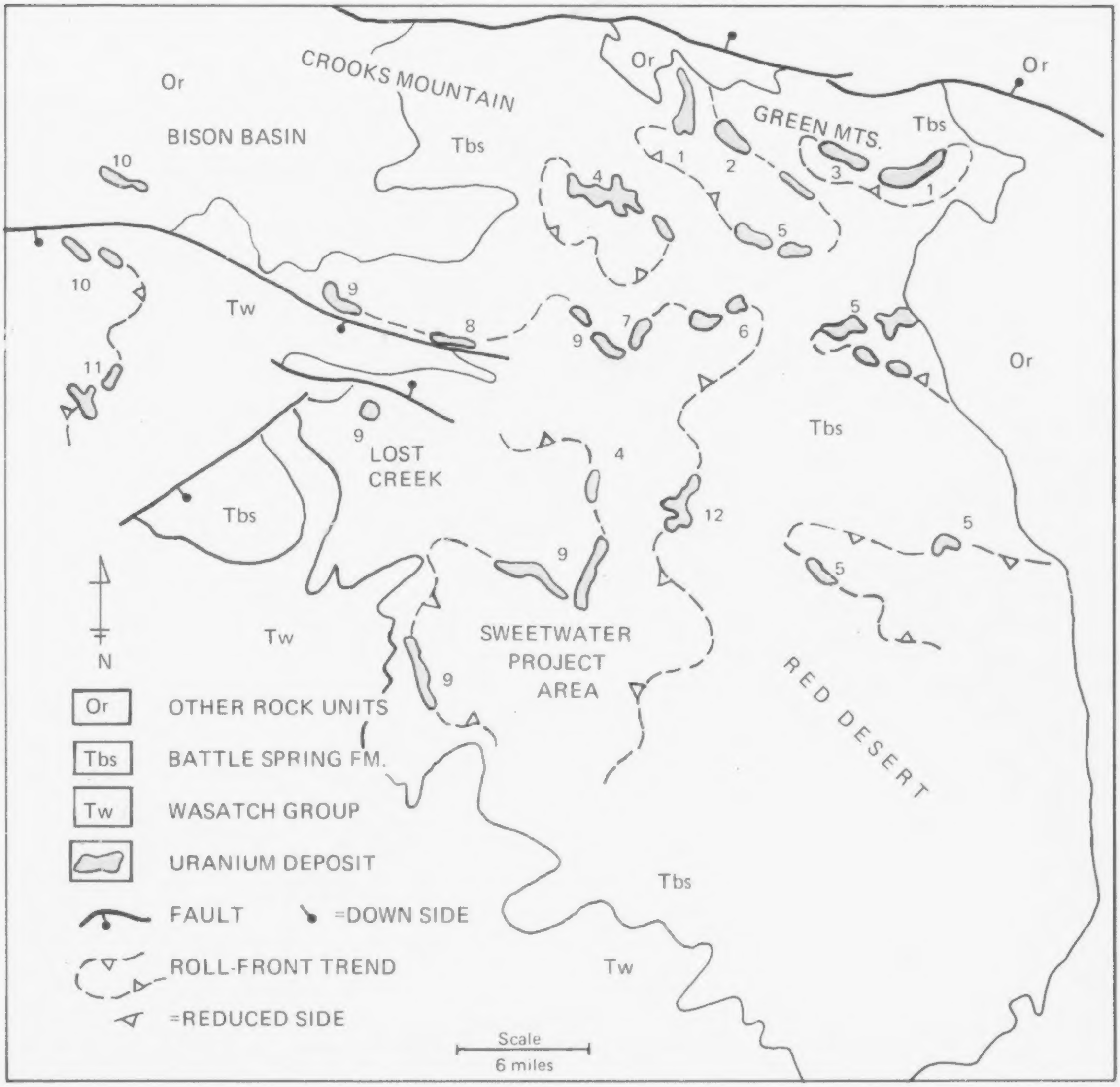
Or
CROOKS MOUNTAIN
Or
Or
BISON BASIN
GREEN MTS.
Tbs
Tbs
10
4
1
2
3
1
5
10
Tw
9
8
9
7
6
5
11
Or
Tbs
9
LOST CREEK
4
Tbs
12
5
9
5
Tw
N
SWEETWATER PROJECT AREA
9
RED DESERT
Or OTHER ROCK UNITS
Tbs BATTLE SPRING FM.
Tw WASATCH GROUP
URANIUM DEPOSIT
FAULT
=DOWN SIDE
ROLL-FRONT TREND
=REDUCED SIDE
Tbs
Tw
Scale
6 miles

Figure 3

GEOLOGIC MAP OF THE NORTHEAST PORTION OF THE GREAT DIVIDE BASIN, WYOMING SHOWING LOCATION OF URANIUM DEPOSITS AND ROLL-FRONT TRENDS. NUMBERS IDENTIFY OWNERSHIP OF ORE DEPOSITS (SEE TABLE 10)

STATISTICAL DATA

EXCHANGE VALUE—$25.00/lb U_3O_8
Determined as of May 31, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:
A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:
A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of May 31, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
25.70	2.9	12	7

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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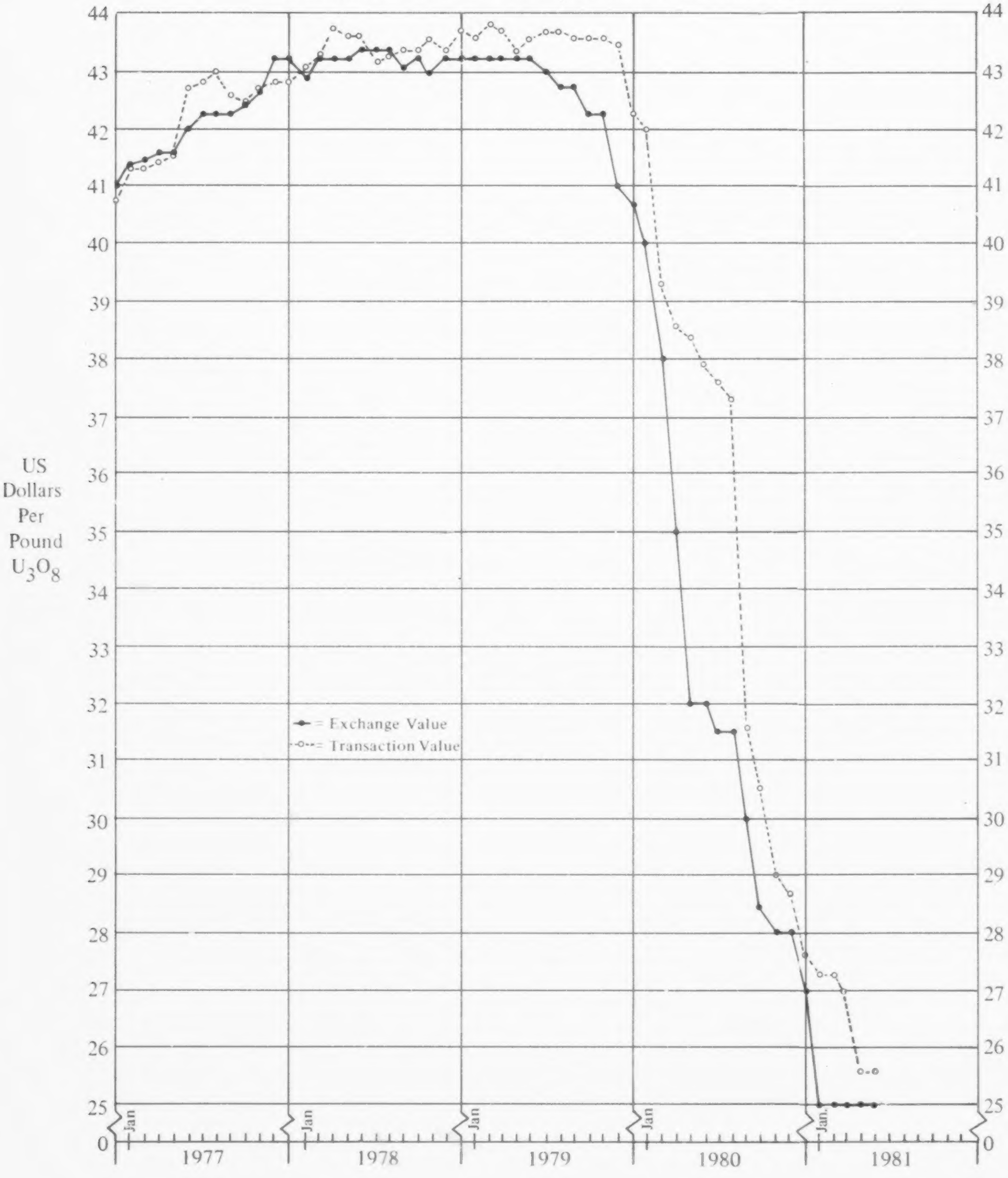
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00							

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70							

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	25.00	55.11	64.99
France (franc)	137.89	304.00	358.49
FRG (mark)	58.07	128.02	150.97
Japan (yen)	5,598	12,341	14,553
Switzerland (franc)	51.97	114.58	135.12
UK (pound)	12.08	26.63	31.40
Australia (dollar)	21.94	48.38	57.06
Canada (dollar)	30.02	66.19	78.06
Niger, Gabon (CFA)	6,895	15,200	17,925
South Africa (rand)	21.20	46.74	55.12

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

LOAN USE CHARGE RATE—7.0%/year

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

CONVERSION VALUE—$1.15 lb. U as UF$_6$

Determined as of May 31, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1502	81	51–100	92	US	Europe	
1516	81	51–100	100	US	US	UF_6
1517	82	301–600	100	US	Europe	UF_6
Conversion Transactions						
1514	81	51–100	122	US	US	

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*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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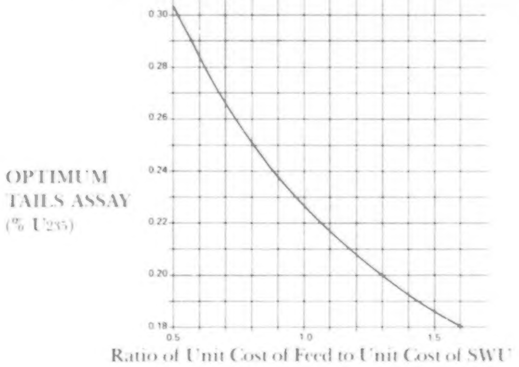
STATISTICAL DATA

OPTIMUM TAILS ASSAY

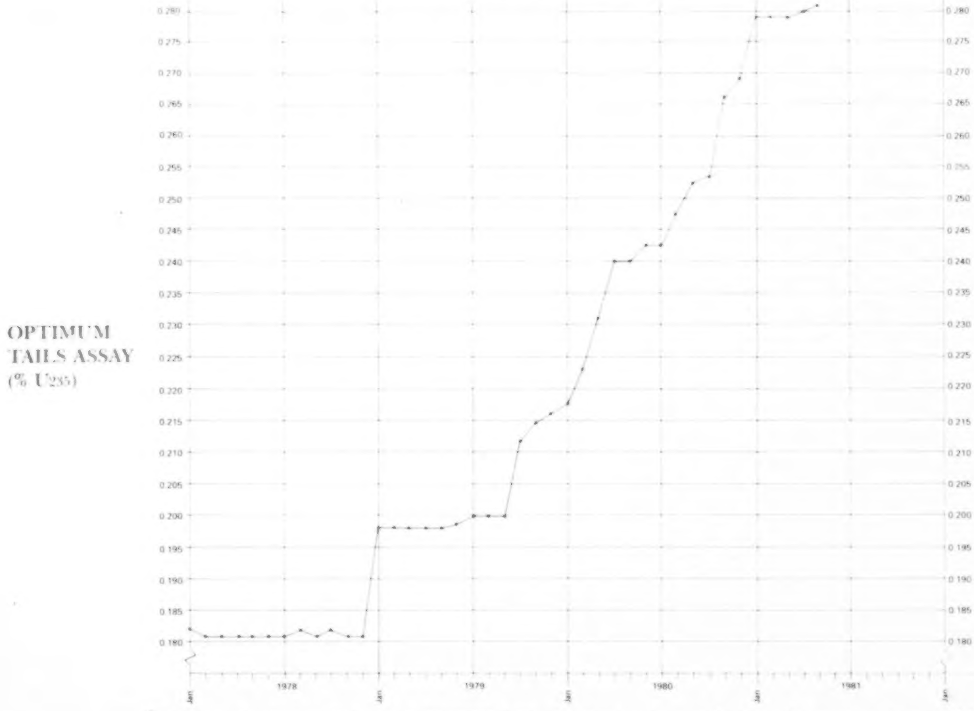
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
Ann. Avg. 1970(5)(7)	110.0	116.3	91.36	3.88	3.87	3.69	3.28
Ann. Avg. 1971(5)(7)	114.1	121.3	96.02	4.12	4.15	3.97	3.49
Ann. Avg. 1972(5)(7)	117.9	125.3	100.00	4.56	4.59	4.26	3.71
Ann. Avg. 1973(5)(7)	125.9	133.1	105.80	4.84	4.98	4.51	3.91
Ann. Avg. 1974(5)(7)	153.8	147.7	116.02	5.44	5.63	4.88	4.21
Ann. Avg. 1975(5)(7)	171.5	161.2	127.15	6.13	6.24	5.39	4.64
Ann. Avg. 1976(5)(7)	182.4	170.5	133.71	6.76	6.87	5.91	4.96
Ann. Avg. 1977(5)(6)(7)	195.1	181.5	141.70	7.28	7.67	6.43	5.39
Ann. Avg. 1978(5)(6)(7)	209.4	195.4	152.05	8.23	8.56	7.02	5.82
Ann. Avg. 1979(6)(7)	236.5	217.4	165.46	9.27	9.49	7.60	6.32
Ann. Avg. 1980	—	246.8	177.36	10.26	10.61	8.29	6.96
Jan 1980	260.6	233.2	—	9.91	10.06	7.97	6.67
Feb 1980	265.9	236.4	—	9.92	10.01	8.01	6.71
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05	6.78
Apr 1980	271.3	242.5	—	10.00	10.30	8.12	6.79
May 1980	271.9	244.9	—	10.18	10.37	8.17	6.78
Jun 1980	273.5	247.6	178.93	10.13	10.69	8.24	6.87
Jul 1980	276.2	247.8	—	10.24	10.82	8.35	6.96
Aug 1980	278.2	249.4	—	10.38	10.78	8.39	7.02
Sep 1980	278.8	251.7	182.92	10.54	10.94	8.46	7.14
Oct 1980	282.2	253.9	—	10.58	11.00	8.52	7.20
Nov 1980	283.4	256.2	—	10.73	11.06	8.59	7.29
Dec 1980	286.6	258.4	183.98	10.86	11.31	8.68	7.39
Jan 1981	289.9	260.5	—	10.93	11.30	8.73R	7.42
Feb 1981	294.8	263.2	—	11.16	11.35	8.79	7.45
Mar 1981	298.9	265.1	187.30	11.13P	11.50P	8.81P	7.49P
Apr 1981	302.8P	266.8P	—	—	—	8.90P	7.53P

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Monthly data 1970-1978 for Price Indexes and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Monthly data 1977-1979 for Employment and Earnings SIC codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.

(7) Monthly data 1970-1979 for Employment and Earnings SIC code 36 appear in this report.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[1]
Electric and Electronic Equipment (SIC 36)

Month	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970
Jan	6.12	5.65	5.23	4.81	4.49	4.05	3.83	3.62	3.42	3.17
Feb	6.14	5.67	5.22	4.81	4.50	4.04	3.82	3.64	3.42	3.20
Mar	6.17	5.67	5.24	4.84	4.54	4.06	3.82	3.65	3.45	3.23
Apr	6.12	5.69	5.26	4.80	4.56	4.06	3.85	3.66	3.45	3.24
May	6.22	5.72	5.29	4.86	4.59	4.13	3.86	3.68	3.48	3.26
Jun	6.26	5.74	5.34	4.87	4.64	4.20	3.88	3.69	3.48	3.29
Jul	6.28	5.83	5.39	4.95	4.66	4.22	3.92	3.70	3.50	3.31
Aug	6.37	5.86	5.44	5.00	4.67	4.22	3.95	3.72	3.50	3.30
Sep	6.47	5.94	5.50	5.07	4.73	4.32	3.98	3.76	3.52	3.32
Oct	6.49	5.95	5.51	5.11	4.73	4.37	3.99	3.76	3.52	3.31
Nov	6.52	5.98	5.55	5.13	4.76	4.40	3.99	3.78	3.53	3.33
Dec	6.64	6.10	5.64	5.20	4.83	4.49	4.06	3.83	3.61	3.41
Ann. Avg.	6.32	5.82	5.39	4.96	4.64	4.21	3.91	3.71	3.49	3.28

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(1) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	198.5	190.04
Annual Avg. 1979	248.8	196.34
Annual Avg. 1980	321.7	217.83
Jan 1980	340.1	215.74
Feb 1980	345.6	215.20
Mar 1980	340.3	214.83
Apr 1980	327.9	215.14
May 1980	335.1	214.81
Jun 1980	338.4	214.14
Jul 1980	349.1	221.44
Aug 1980	353.2	219.95
Sep 1980	351.6	219.45
Oct 1980	348.7	220.73
Nov 1980	351.0P	221.10
Dec 1980	353.0	221.43
Jan 1981	359.1	228.30
Feb 1981	358.0	228.12
Mar 1981	356.6P	227.34P

P = Preliminary R = Revised since last month

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(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	**Primary Metal Industries, non-ferrous (SIC 296-298)**	**Chemicals and Chemical Products (SIC 370-379)**
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Annual Avg. 1980	247.1R	10.59	8.05	8.50
Jan 1980	239.0	9.96	7.57	7.99
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.4R	10.58	8.14	8.65
Sep 1980	252.0	10.85R	8.24	8.71
Oct 1980	256.0R	11.05R	8.28	8.82
Nov 1980	257.7R	11.11R	8.38	8.77
Dec 1980	258.3R	11.13R	8.32	8.92
Jan 1981	262.8R	11.27P	8.51P	8.90P
Feb 1981	263.2	11.43P	8.61P	9.00P
Mar 1981	264.6P	—	—	—

P = Preliminary   R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)
Annual Avg. 1970(3)	7.34	100.3(4)	
Annual Avg. 1971(3)	7.88	106.4(4)	59.1
Annual Avg. 1972(3)	8.79	113.3(4)	63.9
Annual Avg. 1973(3)	10.51	124.1(4)	72.3
Annual Avg. 1974(3)	13.18	138.5(4)	85.3
Annual Avg. 1975(3)	16.71	157.2(4)	100.0
Annual Avg. 1976(3)	19.30	174.7(4)	115.1
Annual Avg. 1977(3)	23.87	194.4(4)	130.0
Annual Avg. 1978(3)	27.14	137.2	142.7
Annual Avg. 1979(3)	30.18	155.3	164.5
Annual Avg. 1980	35.53	176.7	192.1
Jan 1980	–	165.4	178.3
Feb 1980	–	167.0	180.5
Mar 1980	33.65	168.0	181.7
Apr 1980	–	170.0	184.2
May 1980	–	171.9	187.0
Jun 1980	34.48	174.6	189.0
Jul 1980	–	177.2	192.7
Aug 1980	–	179.2	196.8
Sep 1980	36.19	182.8	199.8
Oct 1980	–	186.3	203.1
Nov 1980	–	187.8	205.6
Dec 1980	37.69	189.9	206.5
Jan 1981	–	191.0	207.2
Feb 1981	–	193.8	209.8
Mar 1981	–	195.2	209.9
Apr 1981	–	196.4	–

(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."
(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Nuexco Report 140.
(4) April 1970 = 100.00.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1392	400			
1393			175	Long term
1475	1000			UF_6
1480	200	300	300	
1490	1250			
1540	200	750		UF_6
1550	1000			
1562			150	Long term
1575		500	500	Long term
1576	250			
1581	100	150	150	Long term
1595	600	600	800	
1600			200	Long term
1627	1000			
1630	500			UF_6
1637	500	500		
1664	100			
1678		275		
1681	500			UF_6
1685	100			
TOTAL	7700	3075	2275	
Available for Loan:				
1429	400			UF_6
1602	400			
1671	300			
TOTAL	1100			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1052	600			
1423	1000	1000		
1459			200	Long term
1462			100	Long term
1514		400		
1529			550	Long term
1587		275	275	Long term
1603		100	100	Long term
1634		400	400	
1670	100			UF_6
1674	50			
TOTAL	1750	2175	1625	
Inquiries to Borrow:				
1621	300			
1687	200			
TOTAL	500			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1451	75			
1584	200	200	200	Long term
1607		1000	1000	
1609	1000	900	1000	
1619		200	100	
1630	400			
1661		400	400	Long term
1681	400			
TOTAL	2075	2700	2700	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1594		400	950	Long term
1622			400	Long term
1626	75			
TOTAL	75	400	1350	

***Measured from the date of this Report.**

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 154

The **Exchange Value** remained at $25.00 per pound U_3O_8, unchanged from four previous months. Sellers are responding at about this level to open requests for material and large quantities of material are still being discussed at about this price. Two near term transactions involving about 500,000 pounds closed at Exchange Value.

Active inquiries to sell in the spot and near term market total 7.7 million pounds U_3O_8. Over one-fourth of the available material is in the form of UF_6.

Inquiries to purchase in the same time period total 1.75 million pounds U_3O_8. About two-thirds of the available near term material is being offered by holders of inventory, the remaining one-third by primary producers. This represents the highest percentage of available material from inventory in quite some time. As in the past, this increased level of inventory holding could exert additional downward pressure on price.

The **Transaction Value** remained at $25.70 per pound U_3O_8 for the second consecutive month. Three near term uranium transactions are reported this month, involving a total of about 500,000 pounds.

The lack of new buyer interest for conversion services in the secondary market is reflected in the **Conversion Value** decline of 25 cents to $1.15 per pound U as UF_6. One transaction for conversion services in the secondary market is reported this month.

The reclassification of South Africa's uranium resources are tabled in this month's Report. This month's Report also looks at the impact of the Westinghouse situation on uranium supply and demand. The *Topical Essay* concludes the discussion of demand versus Apparent Future Consumption with an integration of the previous essays and draws some general conclusions on the world situation.

The Red Desert area of the Great Divide Basin, Wyoming is featured in this month's *Raw Materials* essay.

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6/81

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COMMENTS OF:

J. R. Wolcott
President
Nuexco

PRESENTED AT:

General Electric 1981 Executive Fuel Conference
May 18, 1981
Hilton Head, South Carolina

NUEXCO

Comments of:

J. R. Wolcott
President
Nuexco

My talk today concerns the challenges of nuclear fuel supply in the 1980's. Most of my comments are related to present conditions, assurance of supply, and market trends. At the end I will describe my estimate of a plausible scenario for the 1985-1990 period.

The whole uranium industry is in the process of change. Even before Three Mile Island (TMI) change was inevitable. But the increased demand anticipated by the supplier industry did not materialize. Now wrenching change is upon the industry through the forces of markets in disequilibrium, mining economics and new ways of utility thinking. More than lack of demand is at work here.

New Versus Old Perceptions

As a starting point, I think it worthwhile to contrast several industry perceptions as they existed four or five years ago, with perceptions today. Previous views were that:

1. US uranium producers would have difficulty *expanding* to meet US demand. A world *shortage* was probable.
2. Expansion of Australian and Canadian production was *essential* to avoid shortages in the early 1980's.
3. Uranium *prices* would continue to *rise* as demand exceeded supply.
4. *Enrichment* capacity would become *inadequate*. It was necessary, therefore, to build enriched inventory in the early 1980's for use in the late 1980's. Artificially accelerated expansion of the production was necessary.

Today's perceptions are the reverse:

1. US *production* is far in *excess* of domestic need. The producer industry is in contraction.
2. Canadian and Australian supply is *optional*—not *essential*. Those nations are expanding production mainly through displacement of higher cost production elsewhere in the world and not by filling increased world demand.
3. *Prices* may be essentially *flat* for some time.
4. *Enrichment* capacity is in *excess*.

The Current Situation

Demand for uranium has virtually plateaued at the moment in the US. World demand is growing, but not rapidly. Nuclear programs in most countries have been slowed. By Nuexco estimate, United States requirements will rise from the 1980 level of 21 million pounds U_3O_8 per year, to 40 million pounds by 1990, and world requirements will rise from 57 million to 100 million pounds during the same period. Projects already under way will account for nearly all the increased consumption.

The producer industry has had no difficulty keeping ahead of demand. In fact, US production currently exceeds consumption by a factor of two to one. Why the disparity? The answer lies in the long term nature of past contracts. Some were negotiated when prices were low and a buyer finds it advantageous to continue to require delivery. At worst, profitable resale is possible. Some contracts were negotiated when prices were higher and may currently be at $50 to $60. Thus the seller requires delivery.

Existing contracts are winding up at the same time that US consumption and supply numbers are becoming more even. Production will decline by five million pounds to 37 million pounds this year, to less than 25 million pounds in 1984 and under 20 million pounds by 1985.

Inventories have been increasing. US utilities own approximately 125 million pounds U_3O_8 equivalent. The Government owns an additional 135 million pounds. At current rates of consumption, all operating US plants could operate more than six years using only utility inventories and for 14 years including use of government inventories. An acute shortage of uranium is not a present danger.

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A large sum of money is tied up in inventory maintenance. The utility owned inventory has a value on the order of three billion dollars. Assuming a cost of money of 20 percent, the annual carrying cost is six hundred million dollars. If one were to include government-owned inventories, the cost would almost double.

High production costs and large inventories have led to a spot market in which usual buyer/seller roles have in some cases been reversed. Half the spot transactions in today's market are inventory-holder-to-producer sales. What was once viewed as a price floor, production cost, is now a price *ceiling* because of this role reversal. We have referred to this situation as an "upside down" market.

I have described conditions for which there is no quick fix. Increased demand would normalize conditions but that will require time. Licensing six reactors per year, the maximum feasible according to the Nuclear Regulatory Commission (NRC), would increase consumption only ten percent per year. Industry needs a 100 percent increase now to retain present production levels.

The Role of Policy and Assurance of Supply

We are prone when looking to the future to think of numbers, charts and graphs and to discount policy. Policy is in fact a vital consideration when assessing assurance of supply. How much *risk* one can afford; how much to *allocate* to reducing risk; and how to *distribute* resources, are matters of policy. Quantitative analysis is taken into account but the final judgment is one based on policy.

It is difficult to describe the full range of choices facing the policy maker. One method is to break down the assurance of supply issue into three dimensions: *collective security, vertical integration* and *horizontal diversification.*

Assurance of supply in this context means assurance of fuel supply for continuity of operations. Assurance of *fuel* supply and assurance of *uranium* supply are not necessarily the same. Uranium is only one element and conversion, enrichment and fabrication are required before uranium is in a usable form. Decision-making has thus become increasingly sophisticated. I would like to discuss some of the implications of supply assurance with respect to buying, inventories and markets. To do so, I will use the three dimensional system outline above.

Collective Security

"Collective security" encompasses provision for oneself, contribution to security of others and dependence upon others. No utility stands alone; all are interrelated by public interest. The same idea is applicable to different nations.

US utilities and the government, as mentioned, own large inventories. However, this inventory is not evenly dispersed. The advantages of large holdings as compared to small holdings are not wholly clear. We know, especially from Oil Embargo history, that the government allocates in a crisis. A company with ample supplies will be asked to aid those in short supply. How much to own for possible benefit to others, as opposed to oneself, is a difficult planning question.

Vertical Integration

"Vertical integration," refers to the form of fuel inventory. Does one gain by owning one pound of U_3O_8 equivalent as fully fabricated fuel or by owning 50 pounds of reserves? Investment requirements may be the same.

Much of the existing inventory distribution is a result of assumptions which have not held true including the forecasts and perceived conditions at the time of contracting. Thus, plans and operating policies developed in the past are no longer appropriate for today's industry.

The cost considerations of inventory have changed as well. Managing a fuel inventory may be a little like managing a stock portfolio. One needs to consider values of assets and price trends. Five years ago the cost of a SWU was approximately \$59; the cost of U_3O_8, \$40 per pound; and the cost of UF_6 conversion about \$2 per pound of contained uranium. Today those costs are \$131 per SWU, \$25 for U_3O_8, and \$1.40 for conversion (secondary market). The change is an increase of

221 percent for SWUs; a decrease of 60 percent for U_3O_8; and a decrease of 70 percent for conversion.

The clear winners, from a portfolio perspective, are those who held enriched rather than natural uranium. Furthermore, they had additional security because the fuel was nearer a usable form.

I do not mean to suggest that a fuel manager can, or should, switch fuel from one form to another in the same way that a mutual fund manager might switch stocks. But over the long pull, economics will cause the fuel manager to change mix as circumstances permit.

Users of uranium are also adapting their roles of direct involvement in the fuel side. The number of US utilities active in exploration, mining or milling has dropped from 24 a few years ago, to 10 or 15 today. Quantitative analysis may show that zirconium is the most critical element of the front end of the fuel cycle where only two or three sources are available and where inventories may only be adequate for a few months.

Horizontal Diversification

The third dimension of the assurance of supply issue is "horizontal diversification", the impact of geographic and nationalistic interests. Here, one examines the costs and benefits of purchasing in various amounts from the US, Canada, Australia and Africa. I think it may be worthwhile in this context to comment briefly upon the three major areas, *Canada, Australia* and *Africa*, which will be responsible for three-fourths of the 1990 world uranium supply. These sources will have major influence on security of uranium supply.

Africa

Africa currently supplies 40 percent of world production and will provide slightly more by 1990. The supplier nations are South Africa, Namibia (formerly Southwest Africa), Niger and Gabon. South Africa and Namibia account for two-thirds of total African supply.

Africa is a continent of turmoil. Over 20 major wars and 35 government coups have occurred during the past two decades. Eight wars involving 15 nations were in progress a little over a year ago. Twenty-one nations have dictatorial governments and economic conditions are continuing to deteriorate.

One might hastily conclude that Africa is high risk, but that view would not necessarily be shared by Africa's clients, nor would the record support such a conclusion. South Africa for example, is rated as the most reliable of world suppliers by most of its uranium customers. However, South Africa's long term risks are greater than its short term risks. While *internal* security is strong, *external* political support is weak. A disruption in uranium supply in the near or intermediate term appears unlikely but remains a possibility.

Australia

Australia will soon produce 12 million pounds of uranium per year, which is a little over ten percent of the world's total. The leading producers are Mary Kathleen Uranium Ltd., Queensland Mines Ltd. and Energy Resources of Australia, Ltd. Mary Kathleen and Queensland will deplete deposits presently being exploited around 1985. Unless new production is added, Australian production will probably decrease to eight or nine million pounds by 1990.

Australia has enormous potential to be a continuing source of uranium. Reasonably assured reserves exceed one billion pounds and much of the continent remains to be surveyed. Uranium has been found in the widely separated provinces of Queensland, the Northern Territories, Western Australia and South Australia. A vast copper deposit in South Australia, known as Olympic Dam, will make large scale by-product uranium recovery economical. Several companies, including Pancontinental Mining Ltd. and Western Mining Ltd., are poised to proceed when market and government clearances permit.

A slight blemish on Australia's reputation for reliability is of concern to some. Australia began production in the early 1970's under a Liberal Party Government. The Labor Party was subsequently voted into power and terminated uranium development except for existing contracts. The Liberal Party was returned to power in 1976 and resumed the development. The

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Labor Party claims it will again stop production if returned to power. However, this is not a realistic approach given the internally divisive nature of the issue.

The worldwide role of Australia is different than the one anticipated five years ago. Failure to expand production or even curtailment, would not be as severe as was once feared. Other nations could, and would, take up the slack—but again I emphasize that I do not believe it will be necessary.

Canada

Canada currently accounts for approximately 15 percent of the world total uranium supply and will supply 26 million, or more than one-quarter of the world total by 1990.

Canada, like the US, has a blemish on its reliable supplier image. Exports were temporarily halted to some nations while bilateral agreements were renegotiated. As in the case of Australia, I doubt that history will repeat itself. Canada is regarded by US buyers as the most reliable of non-US sources. One US utility places Canadian supply on a par with US supply.

A Summation

My objective in the foregoing discussion was to emphasize the broad range of factors in the fuel supply issue. Funding, decisions on source, risk assessment, geography, political trends and future need are all interrelated. One eventually arrives at the equivalent of a point of balance in the three dimensional model I abstractly constructed. But the point is constantly shifting. The objective is to maintain the position as dictated by policy as opposed to one acquired as a consequence of past circumstances.

As a practical matter, we are probably looking forward to significant shifts in the construction of fuel policy. The more critical uncertainties have shifted from yellowcake supply towards readiness for the reactor-to-use side. A shift of investment towards fabricated fuel and away from mining operations is expected. In short, the optimum for the next decade is not what it was for the past decade.

Market Trends

I would like to move next to market trends. Changes including adjustments by the supplier industry are being forced by price pressure, cost leadership of non-US suppliers, new buyer perceptions and governmental influences.

Changes in Cost Leadership

The US, until recently, was the dominant force in the uranium market, responsible for 40 percent of world uranium production and consumption. The US industry was built around low grade ore. Ore grade is usually the most important factor in production cost because low grade means high cost. Currently, average US production cost is around $30 per pound U_3O_8.

In comparison, recent discoveries outside the US have remarkable ore grades. Saskatchewan has qualities as high as 40 to 60 pounds per ton. That compares with an average US ore grade of approximately 2.5 pounds per ton . Australia has millions of pounds in the six to eight pound per ton range. Some are as high as 47 pounds per ton. Some Australian and Canadian production costs for certain ore bodies are less than ten dollars per pound. Much of the production in Western Canada is profitable at less than $25 per pound.

Price leadership eventually follows cost leadership. A cost leader has the ability to move price up or down. If he moves up, a high cost producer will soon follow. If he moves down, he will probably capture a larger market share. The high cost producer cannot readily lower price. This means that long term prices will be determined outside the US. Prices will remain low long enough to allow economics to dominate while market position is being established. Low cost production will replace high cost production as an economic process. After the transition, the political processes will be of more importance than they are today.

Buyer Contracting Attitudes

Buyers' attitudes today differ from the attitudes five years ago, as one might expect, owing to an abundant uranium supply. An upward price threat of a type requiring a hedge is not foreseen. The situation has encouraged buyers to be more demanding. Buyers often press for long-term

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contracts requiring market price in effect at time of delivery. High cost US producers find it difficult to accept such terms while low-cost producers can assume the reasonable risk of a market-related contract. US buyers are, accordingly, dealing with non-US producers more easily than US producers.

Prospects for an Import Embargo

There are political implications for a US producer industry which is declining from 42 million pounds in 1980 to less than 20 million pounds by 1985. US facilities will be idle as dependency upon non-US sources grows. The issue has outward characteristics similar to the automobile industry.

An important question, of course, is whether an import embargo might help the supplier industry. The answer is that it almost certainly would not. The US industry would need both a two-fold increase in consumption and a doubling of current price to sustain it at current production. The embargo would arrive too late in any case. Production will have cut back to half the current level within four or five years.

An import embargo might aid the US supplier industry in the long term. By *1990* the US will be consuming at a rate nearly equal to *1980* production. However, government utilities and consumers would not willingly support excess production above world prices for ten years.

In light of these and other considerations, I do not expect an effective import embargo. I do expect Congressional consideration. However, the closer the scrutiny, the less likelihood that the embargo will be viewed as a solution to the particular industry problem.

Supplier Governments

Three points are worthy of note concerning world supply and the governments associated with it:

First, supplier and user nations are different. The US is the only important exception. Other uranium producer nations export all, or virtually all, production and thus benefit from a high price.

Second, all major supplier nations exercise government control over export terms including price. Canada requires approval by the Uranium Export Review Board, Australia by the Uranium Export Office and South Africa by the Atomic Energy Board. Niger and Gabon operations are owned or dominated by government.

Third, by the end of the decade, three countries and three governmental bodies will supply over 60 percent of the world supply. All low cost sources are under control of those three.

Ironically, US antitrust laws have helped expand non-US government influence. Antitrust laws do not apply to governments. Government price determination is used when governments favor domestic operations suited to their own domestic conditions while at the same time avoiding infringement of US law. The result has been a centrallizing and tightening of world price control.

The Price Outlook

By 1985 US production will be approximately 20 percent of the world total, down from the present 40 percent. US consumption will remain around 40 percent. The influence of the US competitive producer system will have declined. The dominant influence will have moved elsewhere where competition is viewed differently.

Uranium prices continue to be soft and will remain so while uncommitted production exceeds unfilled requirements. Low cost production can expand given even further price depression. If price is determined purely by *economics*, we will see further price declines, possibly substantial ones. Price declines will lead industry in every country, including the US, to seek government assistance.

Effective actions by governments to increase prices will be difficult as long as overproduction and free market mechanisms are dominant. Neither US nor non-US governments have the capability to do much about price while heavy oversupply and inventory conditions prevail.

Once US consumption exceeds US production, establishing a dependency upon imports, non-US government price determination will be a more effective tool. This may take five years as US production will not drop below US consumption until 1983 or 1984.

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Even when government controls do become more influential, a *rapid* jump in prices is not likely. The US lacks only low cost production capability. A too rapid price rise by non-US producers would bring back a viable US industry.

A reasonable guess as to future prices by 1990 would be a low of $30 per pound in future dollars, a high of $50 per pound and a midpoint of $40 per pound U_3O_8. The numbers assume a seven percent rate of inflation. In terms of constant dollars, the price would be a low of $22 per pound, a high of $34 per pound and a midpoint of $26 per pound U_3O_8.

Hypothesized 1985 to 1990 Scenario

If I were a US buyer in need of a 1985 to 1990 picture, I would construct the following scenario. Here I emphasize a mild distinction between *predicting* and *hypothesizing*. I am providing the latter, or what I view as the most plausible set of circumstances taken as a whole. The total scenario in each individual instance will not, most certainly, be realized.

1. Uranium will be abundant well beyond this decade.
2. The price in 1985 will be close to the present level in *constant* dollars. Strong price competition will continue for several years.
3. Major supplier nations' governments will have a growing interest in mechanisms to produce higher prices. Whereas present priorities are first, market share, and second, price, future priorities will reverse and place *price* first and *market share* second.
4. Natural uranium inventories will decline. Most inventories will move toward a zero to two years' supply level with about a 12 month supply level as the goal.
5. Towards the end of the decade, more than half of the US supply will come from non-US sources. Canada, Australia and Africa will be the dominant sources and Canada will be the most favored by US buyers.
6. Utilities will be less involved in exploration, mining and milling. The prior driving forces of price and assurance of supply will remain low.
7. Resources allocated to enhance assurance of supply will be shifted more towards fabricated fuel and less towards natural uranium.
8. Fuel management will be increasingly sophisticated. Techniques, such as operational analysis, will optimize inventory and minimize risks associated with assurance of supply.
9. Enrichment and conversion capacity will be more than ample.
10. Uranium will be purchased more on the spot market and less by long term contracting. Some successful buyers, as now, will rely wholly upon the spot market.
11. World uranium reserves will be adequate. No urgent pressure will be applied to develop alternate technologies because of potential uranium shortages.
12. The US supplier industry will consist of about half the present number of suppliers. All types of recovery, conventional mining, phosphoric, heap leaching, and solution mining, will experience cutbacks. Phosphoric will be the least affected (because of long term contracts). Conventional mining and milling will be the most affected.
13. Increased consumption will continue in France, Japan, Korea and Taiwan.
14. New plant orders during the 1980's will not impact significantly upon the uranium market.

On the whole, the near term outlook is for a competitive, sluggish, over-supplied market. Political forces, if effective, may alter conditions some after the mid-1980's.

Most of you are probably readers of the cartoon strip, "Peanuts." A main character, Charlie Brown, is well known for his philosophic twists. One of his more notable lines is "No problem is so big and so complex that it can't be run away from."

Charlie Brown never met nuclear power. I have described today a fuel industry in difficult straits. The nuclear power industry to which it supplies has large and complex problems. Even so, I remain a long term optimist. I don't think we can "run away" from nuclear power.

On the other hand, I do not believe that major changes in basic conditions are immediately possible. The problems are of the type that require step-by-step rebuilding.

Many energy speeches and papers describe the problems we face, shortages, skyrocketing prices, depleted resources, and so on. None of this, as my remarks indicated today, applies to uranium fuel. Somehow the excesses of uranium and the deficiencies of other fuels have to be brought into balance. The waiting may be difficult for all associated with nuclear power, but may be most difficult for uranium suppliers.

Suppliers will be affected in large measure both by the physical condition of the nuclear power industry *and* by the policies of those in the utility industry. The latitude now available in the policy-making arena, and thus, the potential impact of change, is greater than ever before.

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SPECIAL REPORT JUNE 1981

Uranium: A Market In Transition

A Speech
by
George White, Jr.
Senior Vice President
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Uranium:
A Market In Transition

A Speech

by

George White, Jr.

Senior Vice President

Nuexco

Southern African Metals and Minerals

In a World Context

A Conference Sponsored by

Metals & Minerals Research Services Ltd.

Metal Bulletin Congresses Ltd.

May 11-12, 1981

Uranium:
A Market In Transition

INTRODUCTION

In early May 1981, Mr. George White, Jr., Senior Vice President of Nuexco, delivered a paper on uranium at a conference sponsored by Metals & Minerals Research Services Ltd., and Metal Bulletin Congresses Ltd., two London-based firms. The conference entitled, Southern African Metals and Minerals in a World Context, was held in Johannesburg, South Africa, on May 11-12, 1981.

A slightly edited version of Mr. White's paper appears in this Special Report.

It is a pleasure to be here with you in South Africa, and while my remarks are unlikely to be particularly good news for uranium sellers, I trust you will remember that Nuexco merely reports the market. Consequently, you should not find it necessary to shoot the messenger.

To begin, let me go straight to the bottom line of the current market situation.

1. Uranium prices are down sharply from the highs attained in the latter half of the 1970's.
2. We see little likelihood of any price recovery in the near term or for that matter prior to the mid- or late 1980's.

Figure 1 is a graphic representation of the Exchange Value in current dollars from 1970 to March 1981. As you are well aware, prices were essentially flat in the period 1970-1973, had a meteoric rise in the period 1974 through mid-1976, were essentially stable from mid-1976 through year end 1979, and have been in decline since then.

Figure 1 does not, however, tell the full story of the price decline. Figure 2 focuses on the period 1976 through the present and the Exchange Value has been adjusted to constant April 1976 dollars. We can see the February 1981 Exchange Value of $25 is equivalent to only $15.27 in April 1976 dollars.

Another way to look at this situation would be to use the February Exchange Value of $25 as a base and adjust backwards. The results of this adjustment are seen in Figure 3. Here we see that, in constant February 1981 dollars, the Exchange Value at its peak in April of 1976 was equivalent to $65.49 per pound U_3O_8.

To avoid confusion, let me note here that throughout this paper, dollars are US dollars, and quantities of uranium are millions of pounds U_3O_8. The index utilized in Figures 2 and 3 is the Producer Price Index, published monthly by the US Bureau of Labor Statistics.

I previously noted that we see little likelihood of a price recovery in the near or intermediate term. Two basic reasons argue against higher prices. One factor is the existent and perceived future imbalance between production and consumption. The dimensions of this imbalance are quite beyond those existing in any other commodity of which I am aware. The second reason relates to the cost structure of world production with particular emphasis on Australia, Canada, and South Africa.

PRODUCTION AND CONSUMPTION

During 1980, the United States produced about 42 million pounds U_3O_8. However, US utilities only burned about 18 million pounds to produce electricity. Before you brush this aside as a phenomenon unique to the US, you should recognize that the same approximate ratio also pertains to the world market. Nearly 110 million pounds U_3O_8 were produced, but only about 40 million were turned into electricity. I submit that this is not a situation conducive to price strength. Let me define my use of the word "world" as WOCA or World Outside Communist Area.

Production in excess of consumption results, of course, in increased inventory, the impact of which represents perhaps the greatest unknown in the uranium equation. While there is general agreement about the size and location of uranium inventories, there is, nonetheless, a good deal of mystery as to how these growing stocks will effect the future market. I would like now to consider these three elements: consumption, production and inventory.

Of the three, consumption is the easiest. It is merely the arithmatic summation of what each reactor requires year by year. Given any population and mix

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Figure 1

NUEXCO EXCHANGE VALUE

Determined as of the last day of the month

(U.S. Dollars/Pound U_3O_8.)

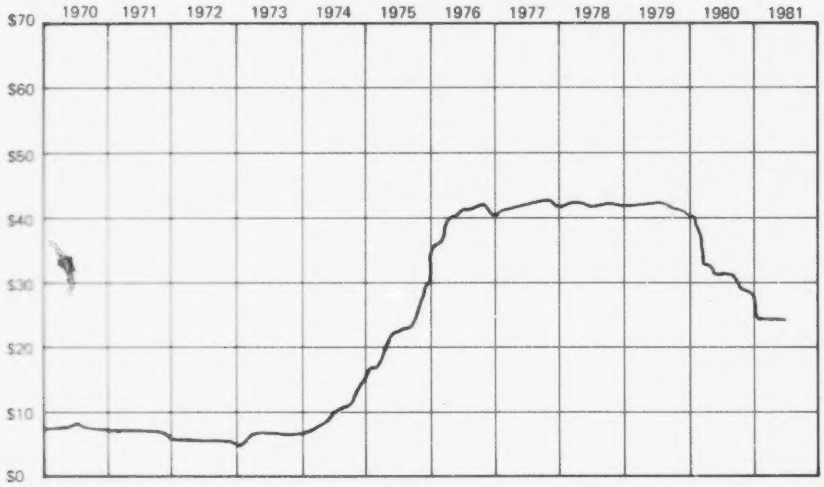

Figure 2

NUEXCO EXCHANGE VALUE EXPRESSED IN CONSTANT APRIL 1976 DOLLARS

Determined as of the last day of the month

(U.S. Dollars/Pound U_3O_8)

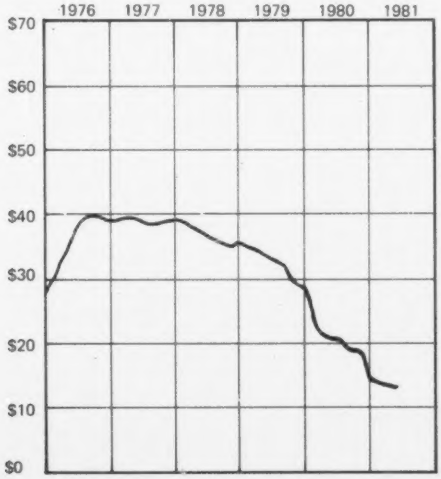

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Figure 3
NUEXCO EXCHANGE VALUE EXPRESSED IN CONSTANT FEBRUARY 1981 DOLLARS

Determined as of the last day of the month
(U.S. Dollars/Pound U_3O_8)

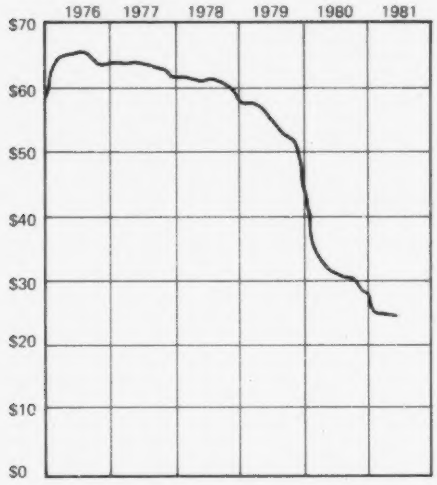
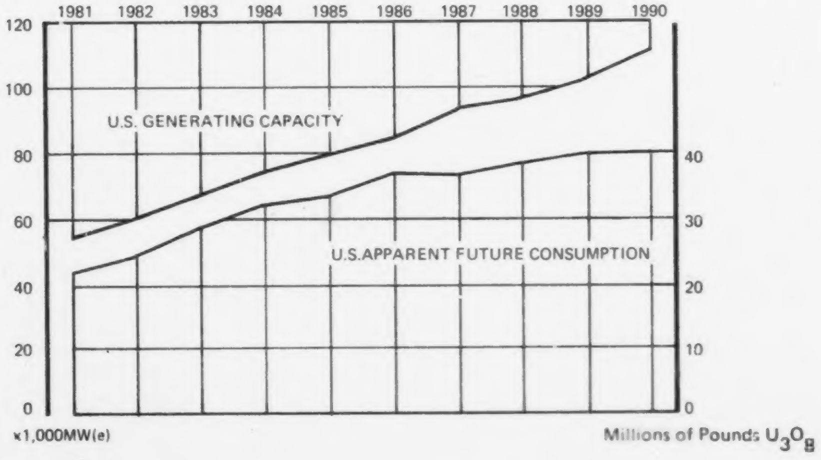


Figure 4
U.S. NUCLEAR GENERATING CAPACITY AND U.S. APPARENT FUTURE CONSUMPTION



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of reactor types, one can construct algorithms that forecast uranium consumption. Assumptions must indeed be made regarding such variables as enrichment tails assay, capacity factors and improvements in fuel design. But again, these are reasonably simple computations. By far the most crucial factor of the consumption picture and the most difficult to gauge is the date when individual reactors will go into operation and begin to consume uranium.

In the US, as a consequence of financial and regulatory constraints and lagging load growth, construction times have lengthened to between ten and 12 years. It is thus possible to say that in 1990, no more than 112,000 MWe nuclear will be in operation, and, therefore, uranium consumption will not exceed 41 million pounds U_3O_8 as Figure 4 shows. It is practically inconceivable that consumption could exceed this amount. However, based on recent experience it is possible, even highly probable, that additional delays and cancellations will reduce this amount still further.

It is also possible to make educated estimates addressing the world situation, although the picture is a bit more difficult to gauge due particularly to uncertainties with respect to France and Japan. If one excludes these two countries, an analysis much like that done for the US can be made. Specifically, it is possible, based on reactors in operation, under construction and on order, to estimate a credible maximum for 1990 online nuclear capacity for most of the significant nuclear power nations. From the capacity total, figures for uranium consumption follow. Numbers for France and Japan, as a consequence of their licensing procedures and shorter construction schedules, have to be more general because, to a certain extent, *some* reactors *not yet on order* may be ordered, licensed, built and begin consuming U_3O_8 before 1990. Figure 5 is a graphic presentation of Nuexco's consumption estimates between 1981 and 1990 including the US. For those of you who may view our estimates of installed capacity as overly conservative, I will offer you an alternate scenario later in this paper utilizing higher consumption estimates for France and Japan.

It should be noted that Apparent Future Consumption of uranium concentrates is specifically defined as the theoretical calculation of a U_3O_8 requirement. It is the amount of U_3O_8 required to enter the fuel cycle process at the U_3O_8-UF_6 conversion plant in order for fabricated fuel to be ready for reactor loading as needed. As such, it is conceptually different than demand. Demand is that quantity of material which the buyer believes he needs or says he needs; it is the measure of a buyer's market impact. Thus, a buyer's demand may be greater or less than anticipated consumption because he may wish to create, add to or liquidate inventory.

Now regarding supply, I noted earlier that worldwide production was about 110 million pounds U_3O_8 during 1980. We anticipate that production will gradually approach 120 million pounds U_3O_8 by 1987 before falling off slightly at the end of the decade. This growth is greater than it may at first appear because we expect the US share of such production to decrease from its 1980 level of 42 million pounds U_3O_8 to about 16 million pounds by 1990. Thus, non-US production will increase over the same period from 68 million pounds to nearly 100 million pounds. The principal additions will come from Australia (the Nabarlek, Jabiluka and Ranger deposits) from Western Canada (the Midwest Lake, Cluff Lake, and Key Lake deposits) and from increased production in Africa.

Please note that these data include substantial cutbacks in the US and take into account only those non-US production centers that we judge to be firmly committed. Thus these data *do not include* any contributions from such well known deposits as Mt. Taylor, Nose Rock, Crownpoint, Immouraren and Roxby Downs.

The point is that, even with this conservative view of future production, we have a picture that looks like Figure 6. The lower line shows estimated future consumption. The upper line shows Nuexco's forecast of future production. It is significant that in every year during this decade production is in excess of consumption. This, of course, brings up the question of inventory. At the end of 1980, world uranium inventories held by utilities, convertors and fabricators approached 312 million pounds equivalent U_3O_8. This figure includes U_3O_8, natural UF_6 and enriched product, but excludes producer inventories, material in the conversion enrichment fabrication pipeline, and national stockpiles. The most notable omission is the 130 million pounds equivalent U_3O_8 owned by the US Department of Energy.

Thus, if we take a mid-case view of consumption, a conservative view of production, and a conservative initial inventory number we see the picture portrayed in Figure 7. This figure is the same as the previous one with the exception that we have had to change the

Figure 5
WORLD APPARENT FUTURE CONSUMPTION

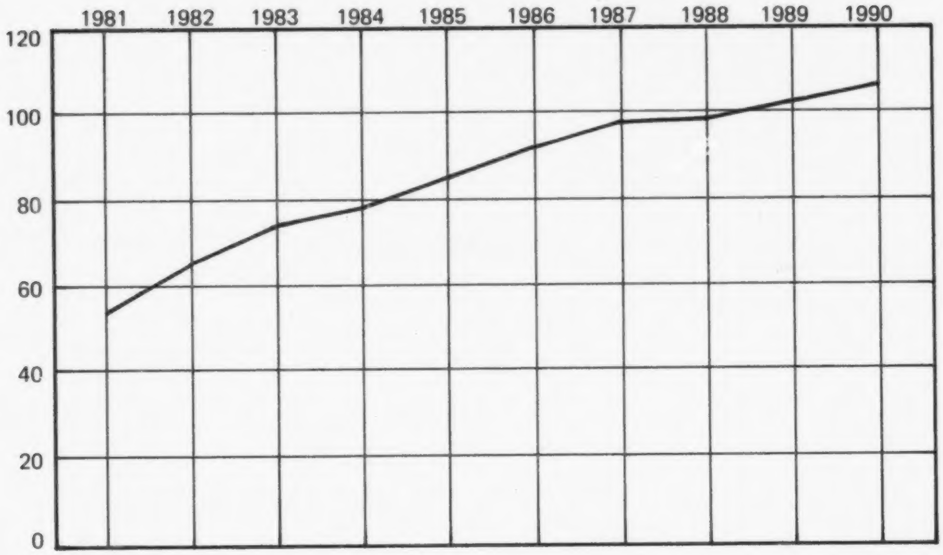

Figure 6
WORLD APPARENT FUTURE CONSUMPTION
vs.
WORLD SUPPLY

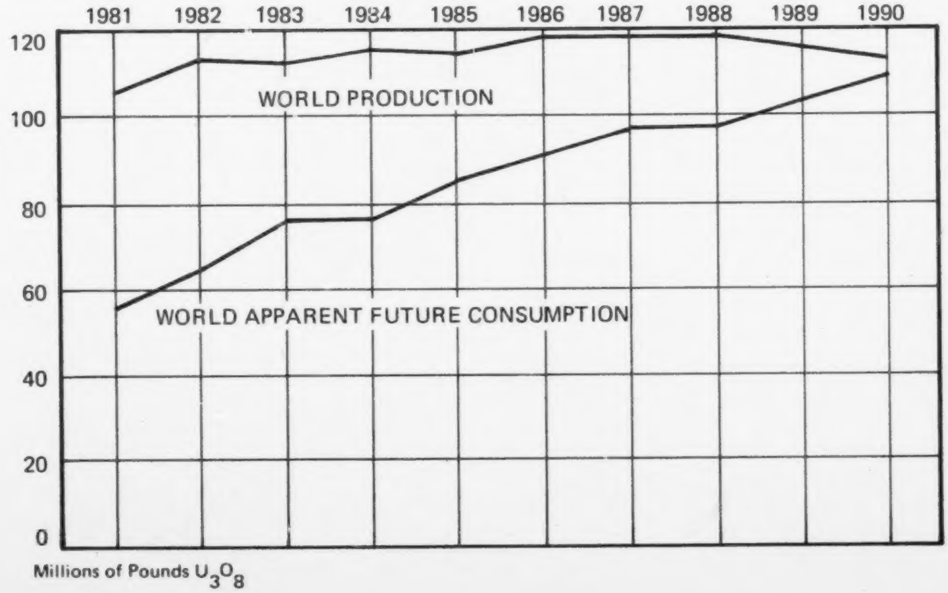

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Figure 7
WORLD APPARENT FUTURE CONSUMPTION vs. WORLD SUPPLY AND SHOWING INVENTORY

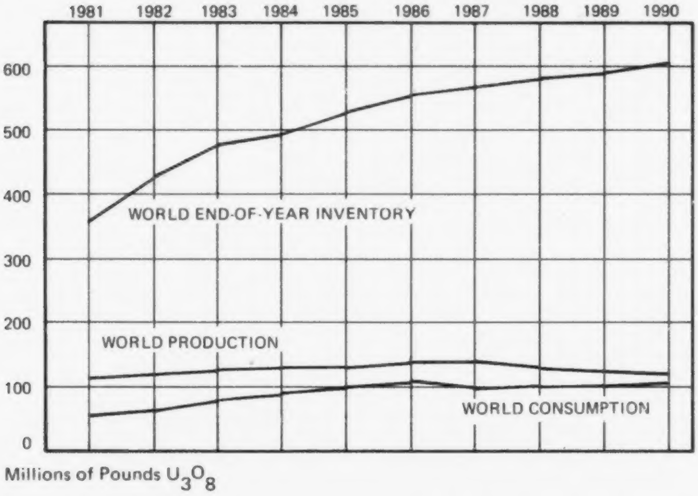
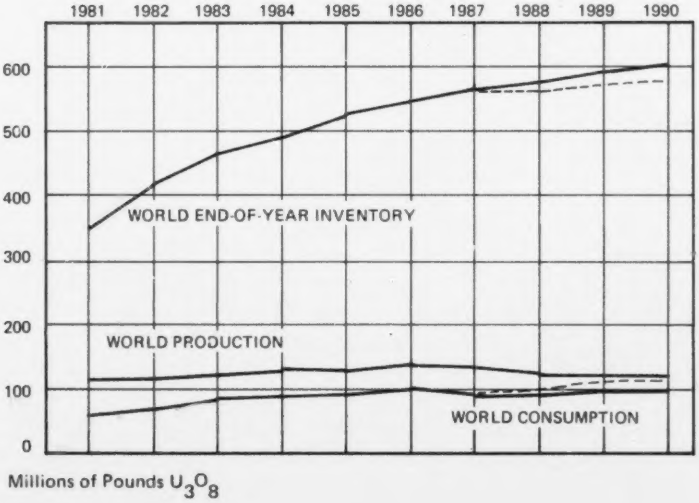


Figure 8
WORLD APPARENT FUTURE CONSUMPTION INCLUDING HIGH CASE JAPANESE AND FRENCH CONSUMPTION vs. WORLD SUPPLY AND SHOWING INVENTORY



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scale and have added an inventory line. As you can see, inventory rises steadily during the decade of the 1980's.

For those of you who view our forecast of future consumption as unduly pessimistic, I have constructed Figure 8, another scenario based on more optimistic consumption estimates for France and Japan. The dotted lines indicate the impact of these higher estimates. Increasing consumption while holding supply unchanged obviously results in lower inventory build up. But again, production is larger than consumption in every year through 1990 and thus inventory still continues to build throughout the decade, albeit more slowly.

As I noted earlier, this is not a picture to warm the hearts of existing and would-be uranium producers.

COST STRUCTURE

The second general, but related factor militating against any foreseeable price strength in uranium, is the cost structure of the production industry, with particular emphasis on South Africa and the emerging areas of Australia and Western Canada.

In a perfect economic world, low cost production will, over time, displace high cost production. While the uranium market is far from perfect, and carries particularly onerous burdens in the form of special political considerations and safeguards policies, we nevertheless anticipate that with some exceptions, the lower cost producers will increasingly dominate the market.

When I use the words "low cost", I refer to those operations which can produce U_3O_8 at costs of less than $25.00 per pound U_3O_8 in mid-1981 dollars. The word "cost" as used here includes everything other than return on investment. Production from existing low cost centers, together with that from new low cost centers and that from certain areas where cost considerations are secondary to national prestige or foreign exchange considerations, will be sufficient, or rather more than sufficient, during the decade of the 1980's to satisfy even the most optimistic forecast of future consumption.

Thus, we are looking at a buyer's market for the foreseeable future.

MARKET CONSIDERATIONS

Up to this point, I have discussed production, consumption and inventory only in terms of their current and forecast relative magnitudes. If production exceeds consumption, inventories increase. Logically, this suggests price weakness. However, the uranium market has never been particularly characterized by logic. Some utilities have committed to purchase quantities which are far in excess of any reasonable anticipated rate of consumption. Others panicked and purchased at prices and under terms and conditions that were absurd even at the time the deals were consummated. Some sellers committed future production at prices guaranteed to lose them money on every pound delivered, or even sold short. It is clear that at different times, the various uranium market participants held rather different perceptions about the future.

In any commercial activity, perception of a situation may well prove more important than its actuality. Due to the long lead times involved in the nuclear industry, actions based on such perceptions can have enormous and long-lasting consequences. Consider the entire Westinghouse situation. Consider the US utility which fearing a uranium shortage, contracted with a seller in 1977 at $40 escalated and is now paying over $60 per pound U_3O_8 under a contract that continues until the mid-1980's and under which the price increases $5 to $6 each year.

Consider the Australians who played politics with uranium for so long that they missed the market top and have had to settle for terms and conditions considerably less advantageous than what they could have obtained had they moved more expeditiously.

Utility buyers are fully cognizant of the current facts and trends of uranium production and consumption. As you might anticipate, new procurement activity abated as prices declined. Indeed, why buy today if better terms and conditions are likely to be available tomorrow? And while the cost of production of electricity by nuclear power is relatively insensitive to the price of uranium, I can assure you that buyers of uranium are not insensitive to its price. Sensitivity to uranium price is a function of several factors: geography; the buyers' past market experiences; and finally and perhaps most importantly, the condition of the market. The corollary to price sensitivity is, of course, concern about supply assurance. Thus you have the picture seen in Figure 9. While hardly a startling revelation to this group, the short history of the uranium market, the dramatic price movements, and the unique nature of the buyers have led to some extreme market behavior.

The sometimes unusual buyer conduct is related to the fact that utilities are unique business organizations. The charter of the utility company, namely, reliable service, dictates a strategy of risk avoidance. There is, in fact, little incentive to take risk, and substantial motivation to avoid it. In business philosophy a utility represents the exact opposite of a mining company. Miners and other industrial enterprises may well and often do take large risks in expectation of commensurate rewards.

Consider the utility uranium buyer. If he successfully buys uranium below market price, the benefits flow not to the company, but to the utility customer in the form of cheaper electricity. If, on the other hand, he pays $45 per pound when market price is $30, he is at the very least, embarrassed in front of his management which will ask him why the company is paying $15 more than the current rate. More importantly the company may be called to task by regulatory authorities. Why take the chance? In the US we have seen the extreme threat requiring that the utility's shareholders rather than the utility customer absorb that extra $15.

Thus, risk avoidance translates into a desire to purchase at market price. Who can criticize you for buying at market? You are merely paying the "going rate."

US utilities, in general, now refuse to enter contracts where the price mechanism might require them to pay more than market. This leads to a "Catch 22" situation for the producer. A guarantee to deliver at market price can, of course, result in delivery at prices below costs of production. New producers in need of outside financing would surely find that such contracts were not bankable.

European and Japanese buyers, compared to the price-sensitive Americans, historically have been observed as taking a longer view of supply arrangements. I would generally agree with this position. However, it would be a mistake to overstate the case. Once supply is assured and more particularly, once an oversupply condition exists, even the conservative Japanese will exhibit price sensitivity. During the past two years they have negotiated successively lower prices with their long-term suppliers. Further, it is our understanding that the Japanese, motivated by the continued softening of market conditions have requested renegotiation of some 1981 prices that were agreed to during 1980.

Having made these comments, it is appropriate to address the question of Australia. While a late comer to the supplier field, Australia has enormous reserves which will almost surely increase further if and when new exploration is undertaken, particularly in the Northern Territory. Based on the size and grade of its reserves and existing government commitments, it seems clear that Australia is bound to become one of the major uranium export suppliers.

There has been a good deal of publicity about the terms and conditions under which Australian material has been sold. These are reported to include minimum prices which are higher than current market levels, market price features and close government review. It would be quite natural to ask, in the light of my previous comments, how the Australians were able to accomplish this.

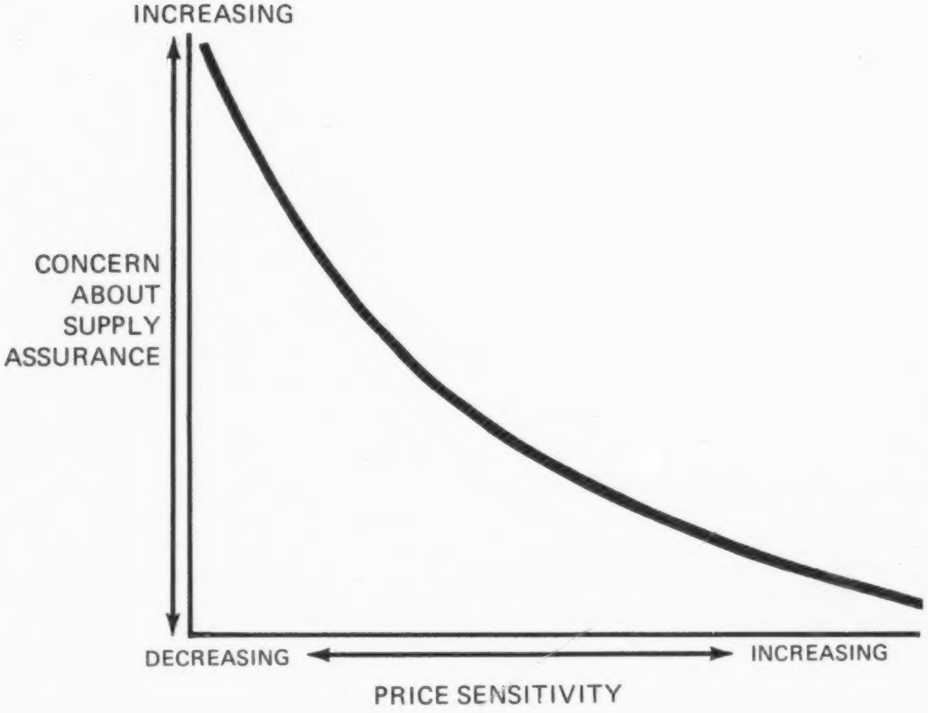
The answer is rather straightforward. Buyers were anxious to encourage Australian committment to uranium production, to get Australia into the game, to provide additional geographic supply diversity and to add a competitor to Canada and South Africa.

The price of insuring Australia's market entrance to an individual buyer is relatively modest—a premium price for a few years on a relatively small portion of total needs. I personally believe that if prices remain at current levels the initial round of Australian contracts will, in all likelihood, be renegotiated once the Australian government finds a politically defensible means to amend its current policies. Please recognize that this is a personal view.

The Canadian sellers, more particularly the Saskatchewan sellers, are also currently in the market. They are active and quite aggressive in the marketing of their large, extremely high-grade deposits. While the Canadian government is involved in export sales approval, it has of late kept a relatively low profile and appears to be developing policy contemporaneously—namely, doing what is necessary to maintain and gain market share.

Before commenting on Southern Africa, I would like to address two other market-related topics. The most likely future scenario for the industry involves substantial cutbacks of US production as current delivery commitments expire and US producers are unable to compete at foreseeable market levels. As US consumption grows, foreign production will fill an increasing share of US needs. Concern has been expressed by non-US producers about a reimposition of the US uranium embargo. After all, we closed our

Figure 9
PRICE vs. SUPPLY ASSURANCE



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market to foreign uranium until 1977, and only last year an unsuccessful attempt was made in our US Senate to reimpose such an embargo.

We do not anticipate a reimposition of any meaningful embargo. The complete rationale is rather lengthy and I will only highlight it briefly here.

1. Primary beneficiaries of a new embargo would be the oil companies. It would be politically unattractive and dangerous to appear to hand more money to these organizations.
2. The dollar volume of the US uranium industry is too small, only about $1 billion annually, to risk the enormous political problems that might be created with such major trading partners as Canada and Australia.
3. The involved regions in the US, namely, Wyoming, New Mexico and Utah are thinly populated and lack political clout.
4. An embargo would meet fierce opposition from the US utility industry and would place the embargo's sponsors in the position of advocating higher energy costs. Politically, this could be very risky.
5. Most important, there is no need for an embargo. Unlike oil, US uranium inventories are huge and growing. In addition to industry inventories, we have a national stockpile. Further our resources in the ground are sufficient to fuel any conceivable level of nuclear power development well into the next century. The US cannot be "OPECed" in uranium.

One is led to the statement, as a friend of mine suggested, "Let's leave our uranium in the ground and rape Australia, Canada and Africa for their resources."

Next, I would like to comment briefly on the inventory situation. For whether or not one agrees with our specific forecast of inventory growth in the long term, there can be no argument but that inventories will increase substantially in the years ahead.

It is equally clear that his inventory is having an impact in the marketplace. This impact takes several forms. The most obvious is the resale of excess material by buyers. Whether motivated by need for cash or regulatory considerations, the effect of this resale is to put downward pressure on the near-term price structure. During 1980 and early 1981, utilities and other buyers have been sellers of several million pounds U_3O_8. We anticipate a continuation of this trend.

Second, the continued inventory growth has the effect of delaying the time when additional material is required, which in turn tends to defer new contracting. The producers, of course, counter with more aggressive marketing, lower prices and other improved terms. The existence of inventory obviously alters the buyer's negotiating posture, normally hardening that posture.

Finally, a more subtle shift in assurance of supply thinking is becoming apparent, as some utilities have determined that there is no compelling reason to carry any inventory at all. With total inventories growing they believe that, even in the event of supplier default, they would have no trouble acquiring the needed material in the spot market, from other utilities or from national stockpiles. Such belief is probably well placed today. It is inconceivable under current market conditions that any reactor could fail to operate due to lack of uranium. Neither the government involved nor neighboring utilities would allow it.

Producers will do well to study the inventory situation: the rate of build-up; its distribution not only by country, but also by utility within countries; the changing utility attitudes as to appropriate inventory size; the imbedded price of existing inventory; as well as the interface with any government stockpiles.

As an American coming to South Africa for the first time, I might be excused for having the normal biases imposed by exposure to the US media. Fortunately I have had the opportunity to know and work with a number of South Africans and believe I've been somewhat deprogrammed.

It is nevertheless true that some buyers perceive Southern Africa as the least stable of the major producing areas. Please note that I said perceive, and recall that the perceivers are utilities, mostly US utilities, bent on risk avoidance. These perceptions include: the uncertain situation in Namibia; questions about the long-term stability of South Africa; and the omnipresent public relations aspects of South Africa's racial position. For these utilities, long-term contracting from Southern Africa is not likely in the present climate. Individual fuel managers recognize the exemplary delivery record and the high standard of South Africa's product, reported to be the world's most uniform in quality. However, their restraint is institutional in nature.

As you are well aware, other buyers in Europe and the Far East, as well as some non-utility US buyers, have enjoyed excellent commercial relationships with

South Africa. Consequently the general reluctance of US utilities to follow must be attributed to their own special considerations. In this regard, I would reiterate my view that the intense interest in Australian uranium shown by many of South Africa's customers is a function of their wishing to increase both competition and diversity of supply as opposed to any turning away from South Africa.

The situation as regards Namibia must, in truth, be viewed as less than optimum insofar as inspiring confidence in potential new buyers. It would seem that realistically, any government coming to power there would require the foreign exchange, taxes, employment and other benefits associated with Rossing. On the other hand, I would judge that development of even new low cost production in that area would have to await resolution of the present uncertainties.

South Africa on the other hand would appear to be well positioned for the forthcoming market period. Based on my previous comments, we anticipate a difficult market characterized by oversupply—and aggressive competition for market share, particularly from new production in Australia and western Canada.

With its facilities in place, South Africa's by-product producers should be able to compete effectively, its marginal gold producers and primary uranium producers less so. Sales opportunities beginning in the mid-1980's are being reduced by nuclear power plant delays and cancellations, inventory buildup and continuing and aggressive sales efforts. Any decision by South Africa to stay out of the market pending price improvement is risky for a number of reasons. First, if we are correct, price is not likely to improve. Second, whether or not prices improve, many or most of the best sales opportunities could already be filled. Third, adverse movements in the gold price, coupled with a continuation of the high rates of working cost within the gold mining industry could seriously erode the competitive positions of those weaker producers with uncommitted supplies.

Obviously the decision to sell or not to sell and under what terms and conditions is one that can be made only by South African producers. Presumably, they conduct their own analyses and forecasts, and will move when they judge it to be in their economic self-interest. If the picture I have painted here today proves correct, stockpiling uranium would appear to be of questionable economic merit.

Having made the previous statement I must at once modify it, by recognizing that the South Africa uranium industry is not monolithic. Even were each of the mining houses to agree 100 percent with the analysis presented here, it is likely that each would respond differently. Furthermore, it is probable that the different responses would be appropriate for different mines in any one group. The differences in depth grade, gold-uranium ratio, marginal production cost and the size, duration and pricing of their existing uranium delivery commitments all argue that a given economic environment will necessitate different responses.

I would conclude, however, on a more optimistic note. Nuclear power will continue to grow as an energy source. We really have no other choice. And uranium consumption will follow this growth. Neither will increase fast enough to make producers happy in this decade, but increase they must.

Appendix

The data used to plot the figures are tabled for reference.

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Table 1
NUEXCO EXCHANGE VALUE*

Determined as of the last day of the month indicated (US Dollars/pound U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	25.00						

*The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Table 2
NUEXCO EXCHANGE VALUE EXPRESSED IN CONSTANT APRIL 1976 DOLLARS+

Determined as of the last day of the month indicated (US Dollars/pound U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	35.74	37.42	39.48	40.00	39.91	39.69	39.43	39.59	39.96	39.64	39.95	39.40
1977	39.53	39.34	39.08	38.76	38.95	39.08	38.84	38.65	38.61	38.67	39.04	38.90
1978	38.32	38.39	38.16	37.79	37.69	37.45	37.20	36.72	36.66	36.07	36.06	35.86
1979	35.41	35.01	34.56	34.01	33.63	33.10	32.38	31.96	31.12	30.52	29.47	29.00
1980	27.64	25.74	23.47	21.24	21.20	20.74	20.54	19.42	18.41	17.93	17.84	17.27
1981	15.53	15.27	15.06	14.87								

+The US Producer Price Index is used to standardize data.

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Table 3

NUEXCO EXCHANGE VALUE EXPRESSED IN CONSTANT FEBRUARY 1981 DOLLARS+

Determined as of the last day of the month indicated (US Dollars pound U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	58.51	61.26	64.64	65.49	65.34	64.98	64.55	64.82	65.42	64.90	65.41	64.51
1977	64.72	64.41	63.98	63.46	63.77	63.98	63.59	63.28	63.21	63.31	63.92	63.69
1978	62.74	62.85	62.48	61.87	61.71	61.31	60.90	60.12	60.02	59.05	59.04	58.71
1979	57.96	57.30	56.57	55.68	55.05	54.17	53.00	52.32	50.94	49.96	48.23	47.46
1980	45.25	42.13	38.41	34.77	34.70	33.95	33.62	31.79	30.14	29.35	29.20	27.82
1981	25.42	25.00	24.66	24.34								

+The US Producer Price Index is used to standardize data.

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Table 4-A
US NUCLEAR ELECTRIC GENERATING CAPACITY[1] [2]
(thousands of MWe—net)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Reactors now operational	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8
Now under construction	3.2	8.2	14.7	21.5	28.2	34.6	41.1	47.1	54.3	60.8
Now on order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
US Total	54.0	59.0	65.5	72.3	79.0	85.4	91.9	97.9	105.1	111.6

[1] Installed as of year end.
[2] Uses Nuexco estimates of commercial operating dates.

Table 4-B
US APPARENT FUTURE CONSUMPTION[1]
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Reactors now operational	16.3	16.6	17.0	17.2	17.3	17.3	17.2	17.1	17.0	16.8
Reactors now under construction	4.6	6.3	10.1	13.2	15.5	18.2	17.9	20.5	23.4	23.5
Now on order	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
US Total	20.9	22.9	27.1	30.4	32.8	35.5	35.1	37.6	40.4	40.3

[1] Computed quantities of U_3O_8 which would be used under the given conditions, to fabricate fuel for loading and reloading reactors operating, under construction or on order as of October 31, 1980. Compiled and computed on a reactor-by-reactor basis, quantities for each reactor are based on specific core characteristics, 0.25 percent tails assay, no recycling, 24-month lead time for procuring first cores and 18-month lead time for procuring each reload. Where reload schedule is not already known, these estimates assume reloads occur one year after commercial operating date and annually thereafter. Nuexco estimates of individual reactor capacity factors are used.

Table 5
APPARENT FUTURE CONSUMPTION[1]
(millions of pounds U_3O_8)

BUYER GROUP	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
United States	20.9	22.9	27.1	30.4	32.8	35.5	35.1	37.6	40.4	40.3
Europe	25.6	28.9	35.4	30.8	36.3	38.0	44.9	42.4	43.3	42.7
Far East[2]	6.9	6.9	6.8	11.1	11.7	11.6	11.7	12.4	13.3	14.2
Other WOCA[3]	3.1	5.1	5.9	5.1	4.6	5.9	7.5	7.2	5.6	6.1
WOCA TOTAL	56.5	63.8	75.2	77.4	85.4	91.0	98.6	99.6	102.6	103.3

[1] Computed quantities of U_3O_8 which would be used under the given conditions, to fabricate fuel for loading and reloading reactors operating, under construction or on order as of October 31, 1980. Compiled and computed on a reactor-by-reactor basis, quantities for each reactor are based on specific core characteristics, 0.25 percent tails assay, no recycling, 24-month lead time for procuring first cores and 18-month lead time for procuring each reload. Where reload schedule is not already known, these estimates assume reloads occur one year after commercial operating date and annually thereafter. Nuexco estimates of individual reactor capacity factors are used.

[2] Japan, Korea, People's Republic of China, Taiwan.

[3] Excludes Bulgaria, Czechoslovakia, German Democratic Republic, Finland (two Russian reactors), Hungary, Poland, Romania, USSR.

Table 6
WORLD URANIUM PRODUCTION FORECAST[1]
(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Australia	5.8	10.8	10.8	10.8	12.0	15.0	15.0	15.0	15.0	12.0
Canada	16.4	19.6	19.4	22.2	23.0	25.0	27.0	27.4	27.4	27.4
Niger, Gabon	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
France	7.4	7.7	7.8	8.3	8.3	8.3	8.3	8.3	8.3	8.6
Namibia	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Rep of South Africa	18.9	19.8	20.4	20.9	21.3	21.7	21.5	21.5	21.4	21.4
Other Nations[2]	1.4	1.5	2.5	2.7	3.2	3.2	3.2	3.2	3.2	3.2
Non-US Total	75.2	84.7	86.2	90.2	93.1	98.5	100.3	100.7	100.6	97.9
US	31.0	26.9	26.1	24.0	21.1	19.5	18.4	16.8	16.3	15.8
Total (Rounded)	106	112	112	114	114	118	119	118	117	114

[1] World Outside Communist Areas.

[2] Includes Argentina, Belgium, Brazil, Chile, Portugal, Spain, and others.

Table 7
URANIUM SUPPLY-DEMAND BALANCE: WOCA[1]

(millions of pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
PRODUCTION Total	104.2	111.6	112.3	114.2	114.2	118.0	118.7	117.5	116.9	113.7
Less CONSUMPTION	56.5	63.8	75.0	77.4	85.4	91.0	98.6	99.6	102.6	103.3
Equals										
NET INVENTORY INCREASE	47.7	47.8	37.1	36.8	28.8	27.0	20.1	17.9	14.3	10.4
Plus										
BEGINNING INVENTORY	311.9[2]	359.6	407.4	444.5	481.3	510.1	537.1	557.2	575.1	589.4
Equals										
ENDING INVENTORY	359.6	407.4	444.5	481.3	510.1	537.1	557.2	575.1	589.4	599.8

[1] World outside Communist areas.

[2] Nuexco estimate.

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JULY 1981 NUMBER 155

Monthly Report on the Uranium Market

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 155

The **Exchange Value** decreased 75 cents to $24.25 per pound U_3O_8. The large quantities of material available at $25.00 over the past few months in most cases have either been removed from the market or have been reoffered at prices below $25.00 in order to stimulate buyer interest. Two sales of significant quantities to utilities are reported this month at prices close to current Exchange Value.

Active inquiries to sell in the spot and near term market declined almost two million pounds to a total of 5.2 million pounds U_3O_8 or its equivalent. The ratio of inventory holders to primary producers as sellers remained fairly evenly split. Close to half of the available material is in the form of UF_6 which must either be swapped or deconverted in order to respond to requests for U_3O_8. Total of inquiries to purchase in the spot and near term market decreased to about one million pounds. However, a larger number of utilities are represented in the active buyer category.

The **Transaction Value** decreased $1.20 to $24.50 per pound U_3O_8. The higher priced transactions from the end of 1980 have been replaced by recent transactions priced at about current Exchange Value. There are four uranium transactions reported this month, including one loan. The total of material involved approximately 1.5 million pounds. The **Loan Use Charge Rate** decreased to 5-1/2 percent. Activity in the loan market increased and is being discussed at about this level.

The secondary market for conversion services has been quiet this month since demand has been primarily in the intermediate term (one to five years). The **Conversion Value** remained at $1.15 per pound U as UF_6 for the second month. There are several offers outstanding on the spot and near term markets to sell conversion at this price level.

The future of France's nuclear power program in light of the recent election results is discussed in this month's *Commentary*. This month's *Topical Essay* begins a series of discussions on unconventional types of transactions with a look at inventory upgrading.

A reevaluation of reasonably assured resources (RAR) of the Free World is presented and commented upon in this month's *Raw Materials* essay.

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NUEXCO

MONTHLY REPORT ON THE URANIUM MARKET
July 1981 No. 155

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URANIUM MARKET

GENERAL

The out-of-court settlement between Westinghouse Electric Corp. and Phibro Corp. marks the end of a unique phase in the short commercial history of the uranium market. The Westinghouse cases were the centerpiece of this unusual drama stretching almost six years. It is interesting to note that the price of uranium in current dollars, as measured by Nuexco's Exchange Value, was essentially the same in June 1981 ($25/lb. U_3O_8) as it was in September 1975 ($26/lb. U_3O_8) when the Westinghouse cases began.

With perfect hindsight it is now possible to see that the procurement activity that drove up prices in late 1975 and 1976 was, for the most part, unnecessary because forecast consumption levels failed to materialize. The price rise consequently motivated new exploration development and accelerated production decisions which helped lead to the present excess supply condition. This condition has been further aggravated as reactor cancellations and delays continue to reduce uranium requirements.

Commodity experts unfamiliar with uranium react with disbelief when told that the uranium market was simultaneously characterized by rising prices, increasing supply *and* falling demand. The explanation of the apparent paradox is four fold: uranium is a single use commodity; long lead times are associated both with uranium development and its end use in reactors; utility companies, the only consumers of uranium, are characterized by an unusually conservative nature; and finally, forecasts of uranium requirements have tended to be very optimistic.

Barring some now-unforeseen event that alters buyer perceptions, the current and projected imbalance between production and consumption suggests that a near-term price rebound is unlikely. Producer competition for limited sales opportunities has already impacted on marginal operations worldwide. The shake-out will likely continue for some time.

The experience of the past several years does suggest certain aspects for the future. first, any concerns about adequate uranium supplies have been erased. Exploration inspired by the dramatic price rise resulted in the identification of uranium resources capable of supporting almost any realistically conceivable level of nuclear power growth well into the next century. Second, it is clear that both buyers and sellers have gained in sophistication, and thus the market itself is more likely to behave in an increasingly rational and predictable manner. These two factors in turn define a more perfect market than has previously existed, which will likely produce a price ceiling associated with the marginal cost required to fill the last pound of demand.

AUSTRALIA

The previously reported sale (Nuexco Report 146) of 3.15 million pounds U_3O_8 from Energy Resources of Australia (ERA) to Synatom of Belgium has been approved by the Australian government. The sale is contingent upon the Australian safeguards agreements with Euratom coming into force. ERA has now sold enough uranium to cover the first ten years of its projected annual production of 6.6 million pounds U_3O_8.

The Australian government's uranium pricing policy involving a floor price established some time ago, is viewed by some in Australia as unrealistic in light of the current depressed uranium market. However it still appears likely that the Australian government, while conscious of substantial price falls since the floor price was established, will try to maintain at least its concept. In any event, it may be prepared to modify its application by encouraging "creative" interpretation of the policy on the part of sellers.

The extent to which such creative interpretation actually materializes remains to be seen. But the Australian government faces a difficult balancing act in deciding what is better in the national interest, the strict maintenance of an arbitrary floor price or the deferment of new uranium developments. In the case of a large producer, such as Jabiluka, strict construction of the pricing policy in the light of competing production, especially from Canada, could lead to substantial deferral of the project due to lost sales. The Australian government will face similar policy challenges if additional sales opportunities arise for the existing producers, such as ERA or Queensland Mines and Mary Kathleen.

Thus the Australian government appears to be at a crossroads of either changing its policy to adapt to the new market; or to retain the policy on its face, perhaps with some interpretive latitude. It appears most likely at this time that the government will adopt the latter approach. Politicians generally prefer

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to avoid risk, and it would seem that omission to act officially would, in this instance, not incur as heavy a political risk as a highly visible change in the floor price policy.

CANADA

At least three contracts have been completed for the sale of Saskatchewan uranium production to US and European utility buyers. The agreements have been signed and are awaiting the necessary approvals by the Canadian government. The approval process is expected to require about sixty days, after which purchase announcements will likely be forthcoming from the respective buyers.

The finalization of these contracts is very significant in at least two respects. First, they represent the first truly arms-length sales of production from the new deposits in Western Canada. The production previously committed was based on equity participation in the projects, or at least has the flavor of government-to-government deals. These latest sales are truly commercial and represent a breakthrough.

Even more significant is the fact that at least one of the buyers is US. Other US buyers are also negotiating for the long term supply of U_3O_8 from Western Canada, and additional contracts will likely be forthcoming this year. It now appears that a substantial portion of new uranium contracts signed by US buyers in 1981 will be with Canadian sellers.

EUROPE

According to data recently published in the USSR, nuclear power accounted for 5.4 percent of Soviet electric energy production in 1980. Current plans call for this to increase to between 14 and 14.8 percent by 1985. By the year 2000, the USSR plans to obtain about 60 percent of its electric energy from nuclear power. The other members of the Council for Mutual Economic Assistance (CMEA)—Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, Poland and Romania—anticipate similar expansion of nuclear capacity. The Soviets have controlled capital costs of nuclear plants with standardization of reactor units and modular construction.

The USSR and the other COMECON countries have not yet participated in the commercial uranium market in the West. However the ambitious nuclear development plans might begin to tax COMECON's domestic uranium resources. Thus uranium purchases by the Soviet Bloc nations might be expected eventually, especially in view of the depressed state of the uranium market.

Italy plans to announce a revised program for nuclear generating capacity within a few weeks. The new plan is expected to call for 6,000 MWe of additional nuclear capacity to be on line by 1992, including Montalto units 1 and 2, which are currently under construction. The cognizant regional and local governments have indicated that the proposed nuclear station sites are acceptable in principle, subject to negotiating appropriate compensation to the affected communities.

FAR EAST

Construction of a pilot plant in Japan to recover uranium from sea water will begin in July 1981 and represents the culmination of five years of basic research and development. Located in Kagawa Prefecture, near Nio City, the plant is scheduled for operation in 1984. Responsibility for the design and construction of the plant rests with the Japan Metals and Mining Agency with funding provided by the Ministry of International Trade and Industry (MITI).

The plant's total cost is estimated at about $10 million but annual production is anticipated to be only about 25 pounds of U_3O_8. Obviously such economics indicate a continuing research and development effort. The stated long term goal is a full scale plant capable of producing two million pounds annually in the post 2000 period. Full scale costs of Japan's proprietary sea water process are estimated in the range of $160 to $340 per pound U_3O_8.

Tokyo Uranium Development Company (owned by: Marubeni 57.5 percent, Nippon Mining 30 percent, Fuji Bank five percent, Industrial Bank of Japan five percent and Yasuda Insurance 2.5 percent) announced a resumption, with French cooperation, of uranium exploration in Maritania. A similar effort in that country was halted in 1975 by political turmoil. The new program is modest and will involve Japanese expenditure of only about $650,000 over the next three years. Even if successful, production is not contemplated until after 1990.

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By US standards, neither of these developments would probably pass a risk-benefit analysis. However, Japan's decision to move forward is another manifestation of that country's concern about security and diversity of long term raw materials supply.

Following a well-publicized request for proposals, The Philippines' National Power Corporation (**NAPOCOR**) is close to completing a purchase of 622,000 pounds US origin U_3O_8 from a trader who packaged offers from several US producers.

The material, which is to be delivered to the US Department of Energy (DOE) in May 1982 for enrichment, represents the first core of **NAPOCOR**'s 620 MWe PNPP unit 1 located on Luzon's Bataan peninsula. The unit is about 25 percent complete and is currently scheduled for commercial operation in January 1985.

At this point, **NAPOCOR** has not made arrangements for its ongoing uranium needs of about 200,000 pounds U_3O_8 annually beginning in 1986. During the past five years there have been recurring announcements that Australia would provide **NAPOCOR**'s long-term supply. Prior to that, Gabon was mentioned as the long-term supplier. However, in each case these were very general government to government statements with political and diplomatic overtones, but without apparent commercial substance.

The timing and nature of the first core purchase suggests increased market sophistication and price sensitivity. It would not be surprising, therefore, if **NAPOCOR** elected to bide its time and observe marketplace developments, before making further commitments.

UNITED STATES

At least one US uranium producer has officially tabled a proposal[1] to allow USDOE enrichment customers to select the transactional tails assay under requirements type contracts. This option already exists under adjustable fixed commitment type contracts, within certain limits. The proposal outlined several advantages for the uranium industry, as well as for the utilities. Since the proposal could apparently be implemented by administrative action within DOE, it is worthwhile to paraphase the arguments for extending such an option.

If DOE can provide customers holding requirements type contracts an option to select the transactional tails assay, the uranium inventories held by utilities could be utilized faster. A smaller amount of inventory would be expected to be liquidated in the marketplace to compete with material from primary producers.

Many DOE customers with adjustable fixed commitment contracts generally have an unwanted situation of excess uranium inventories and excess SWU's under contract. Thus, with a variable tails option, they must decide on whether to select a high tails assay to consume excess uranium or a low tails assay to consume excess SWU's. This choice is not present for customers with requirements contracts since excess SWU's, by definition, do not accumulate.

Having the opportunity, a customer could select the most economically advantageous tails assay for producing enriched uranium giving consideration to the relative costs for enrichment services and feed uranium. Because of the high level of uranium inventory held by both US and non-US utilities, and because of the relatively low spot market prices for uranium, it would appear that many of DOE's customers would like to use a higher transactional tails assay. If the investment in excess uranium is considered a *sunk* cost, the lowest *forward cost* of producing enriched uranium would probably involve the election of a high tails assay.

The requirements contract, in current form, only permits the use of DOE's standard transactional tails assay which is presently set at 0.20 percent U-235. There is an optimum tails assay which will minimize the overall cost of the enriched uranium needed to fabricate nuclear fuel. The optimum tails assay is dependent upon the relative costs for feed uranium and enrichment services, and is currently about 0.28 percent U-235. (See Statistical Data Section of this Report.) If a DOE enrichment customer were to select 0.28 percent instead of using the standard 0.20 percent to obtain enriched uranium, about 15 percent more uranium feed would be utilized, and the overal cost for the enriched uranium would be reduced.

As one of the provisions which would permit a customer to select the transactional tails assay, DOE could impose an appropriate surcharge upon customers who transact at the standard assay from any adverse cost impacts caused by other customers selecting a non-standard transactional assay. The concept of a surcharge has already been introduced by DOE as a provision for a customer to select the transactional tails assay under the adjustable fixed commitment type contract.

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[1] Letter from J.D. Young, Sohio Western Mining Co. to Senator Peter V. Domenici, April 2, 1981.

Uranium producers in the US continue to respond to the current market situation with announcements of cutbacks and shutdowns. The growing awareness of rising uranium inventories, pessimistic forecasts of demand and the expectation that little real increase in the price of uranium is likely in the short term have forced many US producers to recognize that uncommitted production will have to be produced at a relatively low cost if it is to be sold profitably in the near term. This subject has been the focus of much attention in the US for many months and has been covered extensively in past Nuexco Reports.

Nuexco last published a forecast of US uranium production in Report 147. The forecast was subsequently revised for the years 1981 and 1982 to reflect the fact that it had underestimated the time inertia inherent in uranium production, especially among conventional operations and, to a further degree,

Table 1

SUMMARY OF MAJOR US URANIUM PRODUCTION CUTBACKS ANNOUNCED SINCE MARCH, 1981

Date	Company	Event
3/81	Wyoming Mineral Corp.	Will close Iragary, Wyo. in-situ mining project indefinitely.
3/81	Cotter Corp.	Suspending development of JD7 mine in Colorado.
3/81	Pathfinder Mines Corp.	Laid off another 30 employees at Shirley Basin, Wyo.
4/81	Cleveland Cliffs Iron Co.	Delayed any significant steps in the construction of a commercial mine or mill at Pumpkin Buttes, Wyo.
4/81	Exxon Nuclear Corp.	Cut back Highland production by one-third. Open pit operations cut to working at half rate with underground mine to be phased out by early 1982.
4/81	Pioneer Uravan, Inc.	Closing four of five small Colorado Plateau mines; announced going ahead with 1,000 ton per day mill near Slick Rock, Colorado.
4/81	Homestake Mining Co.	Indefinitely delaying construction of 600 ton per day mill in Colorado. Will be phasing down open pit operations there from three to one shift per day.
4/81	United Nuclear Corp.	Sold its 70 percent share of Church Rock mine and mill to its partner, Homestake Mining Co.
5/81	Sohio Western Mining Co.	Closed Seboyeta, New Mexico mill.
6/81	Sohio Western Mining Co.	Announced closing of Seboyeta mine.
6/81	Western Nuclear, Inc.	Will reduce output at Split Rock to 30,000 pounds annually. U_3O_8 is to be recovered from mine discharge water.
6/81	Plateau Resources Corp.	Stopped construction of Shootering Canyon mill in Utah, but mine development continuing.
6/81	Wyoming Mineral Corp.	Placed all Wyoming mines on standby.

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among open pit operations. Table 1 of Report 152 published a summary of major US uranium cutbacks announced since August, 1980. A summary of US production cutbacks and deferrals announced since March, 1981 are presented in Table 1 of this Report.

Most of the cutback announcements made since the publication of Report 147 and listed both in Table 1 of this Report, and in Table 1 of Report 152 were already taken into account in the Nuexco forecast of US uranium production. This is because most of the announced cutbacks had already been predicted, either on the basis of proprietary knowledge that the change would be made, or by deduction based on other information, such as cost of production, regulatory climate, technical problems, etc. A revised Nuexco forecast at present and the conclusions from such a forecast, would not differ significantly from the forecast of Report 147.

According to data available from DOE, US uranium production from January 1, 1981 through May 31, 1981 amounted to approximately 16 million pounds U_3O_8 (equivalent to an annual rate of 38.4 million pounds). However much of this production came from the running of ore stockpiles through the mills. Thus even in cases where mine cutbacks or shutdowns have already occurred, some mills have continued to operate at high capacity, underscoring again the inherent inertia of conventional mining operations.

The Donaldsonville plant of Freeport Uranium Recovery Corp. was declared commercial as of July 1, 1981. The first U_3O_8 was produced at Donaldsonville on May 21, 1981, and startup was smoother than anticipated. The nominal output of the plant is 420,000 pounds U_3O_8 annually.

TRANSACTIONS

There are four uranium transactions reported this month. One transaction was concluded between a US producer and a US utility for between 300 thousand and 600 thousand pounds U_3O_8, with deliveries stretching over the next ten years. The price is based on market price at the time of delivery. A loan transaction took place from a US utility to a US producer for between 100 thousand and 300 thousand pounds U_3O_8. The loan was made this year, and the material is to be returned by 1986.

A US utility purchased between 300 thousand and 600 thousand pounds U_3O_8 from another US utility. Delivery will take place this year. Finally, a US utility purchased between 300 thousand and 600 thousand pounds U_3O_8 from a US producer, with delivery occurring this year.

PRICING

The **Exchange Value** as of June 30, 1981 is $24.25 per pound U_3O_8, a decline of 75 cents from last month. The market this month was marked by transactions of sizable blocks of U_3O_8 at prices less than $25. In addition, utilities have appeared in the spot and near term markets as active buyers. Two sales of significant quantities to utilities are reported this month at prices close to current Exchange Value. There are fewer sellers in the market, and they are split fairly evenly between producers and inventory holders.

There is some indication that the uranium market is entering a two-tiered phase similar to a divergence which occurred during 1979. (At that time, some buyers were willing to pay a premium for "stringless" uranium.) Now, due to the erratic entrances and exits of major blocks of spot U_3O_8 in the market, a split may be developing between the longer term and spot/near term market. The long term market, which has not seen any major participation by inventory holders, seems to have firmed up at prices above the current Exchange Value. The spot and near term markets are active at the current level for significant quantities as the absorption of excess inventory material, which has been a major market factor for several years occurs in the marketplace. Thus spot and near term material could be bought for on the order of $24.25 or perhaps even less for small quantities. However longer term purchases from primary producers are apparently only available at higher prices at this time.

Material available for near term delivery as presented in the *Market Opportunities* section totals 5.2 million pounds U_3O_8 or its equivalent. Close to half of the available material is in the form of UF_6 which must be either swapped or deconverted in order to respond to requests for U_3O_8. Inquiries to purchase U_3O_8 in the same period totals one million pounds.

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URANIUM MARKET

There has been an increase in material offered for loan in both the near term and longer term as inventory holders look to alternate ways of inventory utilization. The **Loan Use Charge Rate** decreased this month to 5-1/2 percent as a substantial amount of material was offered for loan at about that rate.

The **Transaction Value** decreased $1.20 to $24.50 per pound U_3O_8 as of June 30, 1981. The higher priced transactions from the end of 1980 have been replaced by recent transactions of about current Exchange Value. There were ten qualifying transactions involving 2.9 million pounds U_3O_8.

CONVERSION

The **Conversion Value** remained at $1.15 per pound U as UF_6 for the second month. There are several offers outstanding on the spot and near term markets to sell conversion at this price level. The offers come from holders of uranium inventory in the form of UF_6 wishing to *deconvert* their material in order to respond to inquiries to purchase uranium in the form of concentrates. The fact that there are several inventory sellers in this position, and very little spot/near term demand for conversion services has resulted in the Conversion Value being driven down to this level.

There is some demand in the market for conversion services in the intermediate term (one to five years). However inventory holders are not normally interested in supplying this time frame, and as a result, conversion prices being discussed on the secondary market in this time frame are not as low as prices of transactions on the spot/near term. Normally secondary market sellers in the intermediate term are interested in assigning or subcontracting excess conversion previously ordered from the primary converters, as opposed to deconverting inventory in order to sell concentrates.

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TOPICAL ESSAY

UNCONVENTIONAL TRANSACTIONS: PART I, INVENTORY UPGRADING

The fluctuating uranium price and inventory situation over the past several years have given rise to a variety of unusual transactions and methods of inventory handling. The outright sale of inventory by utilities is just one method used to decrease the amount of money and the time that money is tied up. Another mechanism used to accomplish these objectives would be an inventory upgrading transaction. In this type of transaction, inventory in the form of U_3O_8 or UF_6 is "upgraded" to an equivalent value, and therefore smaller quantity, of enriched material.

Currently there are a number of utilities holding U_3O_8 or natural UF_6 inventories equal to several years consumption. An exchange of that natural uranium inventory for enriched product of the same value would speed up consumption. This would be equivalent to selling part of the U_3O_8 and using the proceeds to buy Separate Work Units (SWU) for enriching the remaining U_3O_8. Since less U_3O_8 would remain, the excess inventory would be consumed in a shorter time. This transaction can also be viewed as selling excess U_3O_8 to generate cash for SWU and conversion payments, instead of paying for these services out of the utility's cash account.

Tables 2 and 3 illustrate this concept. Table 2 shows a utility carrying five years natural uranium inventory. The utility's goal is to carry only a one

Table 2

UTILITY INVENTORY POSITION BEFORE INVENTORY UPGRADING

	Natural UF_6 Inventory			SWU Inventory			
Year	Total Metric Tons U	Excess Metric Tons U	Excess Value ($ millions)	Total Metric Tons SWU	Excess Value ($ millions)	Total Excess Value ($ millions)	Excess Annual Carrying Cost @ 15% ($ millions)
1	1,000	800	54.4	—	—	54.4	8.2
2	800	600	40.8	—	—	40.8	6.1
3	600	400	27.2	—	—	27.2	4.1
4	400	200	13.6	—	—	13.6	2.0
5	200	—	—	—	—	—	—
							20.4

Table 3

UTILITY INVENTORY POSITION AFTER INVENTORY UPGRADING

	Equivalent Natural UF_6 Inventory			SWU Inventory			
Year	Total Metric Tons U	Excess Metric Tons U	Excess Value ($ millions)	Total Metric Tons SWU	Excess Value ($ millions)	Total Excess Value ($ millions)	Excess Annual Carrying Cost @ 15% ($ millions)
1	522	322	21.9	325	32.5	54.4	8.2
2	322	122	8.3	200	20.0	28.3	4.3
3	200	—	—	75	7.5	7.5	1.1
4	200	—	—	—	—	—	—
5	200	—	—	—	—	—	—
							13.6

Assumptions

1. This is a utility with excess UF_6 or U_3O_8 inventory, but with no normal SWU inventory.
2. Annual consumption of natural UF_6 is 200 MTU; goal is to carry one year inventory.
3. Annual consumption of SWU is 125 MTS for 3.0 percent product and 0.2 percent tails; goal is to carry no inventory (buy on current basis only)
4. Each kg U costs $68; each kg SWU costs $100.
5. Owner is able to defer or cancel SWU which he otherwise would have purchased in each year.

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year inventory. The total excess annual carrying charges are $20.4 million. Table 3 shows the effect of upgrading the natural feed into the same market value of three percent enriched product. In year one, the excess value is still $54.4 million. However, it now takes only a little over two years to reach the desired inventory levels instead of four years, so the total excess annual carrying charges are $13.6 million.

To be eligible for an upgrading transaction, a utility will ideally have the following two characteristics:

1. a long natural uranium inventory position, and
2. a short SWU position during the time period in which it will burn the SWU obtained from upgrading.

However, there are very few utilities which meet these criteria. Therefore, the utility must be able to create a short position by cancelling, deferring, or assigning SWU to another party.

As far as the actual mechanism by which the upgrading is achieved, the simplest method is for the upgrading party to sell part of its U_3O_8 and use the money to enrich the remaining U_3O_8. However, many utilities have encountered problems which have prohibited them from either selling excess U_3O_8 to procure SWU, or even simply reducing inventory. Obviously, the utility with excess inventory could save additional carrying costs by selling the excess inventory rather than upgrading it. The following are specific reasons why utilities have not chosen or been able to directly sell inventory.

Economic reasons. There may be too little financial incentive, or there even may be a disincentive, to sell excess inventory.

1. The holder may not want to realize capital gains (or losses), or other consequences resulting from the sale.
2. A sale may reduce rate base earnings or Allowance for Funds Used During Construction (AFC) "earnings", if excess inventory has been allowed in the rate base or construction work in progress base.
3. The holder might be concerned that the subsequent replacement of the inventory could be at a much higher market price, or replacement might otherwise be difficult, and this would threaten its security of supply.
4. The inventory may be pledged to support the utility's bonds, or it may be owned by a leasing company.

Institutional reasons

1. A sale could draw unwanted attention to the situation of excess inventory by the management, the Public Service Commission (PSC), or the press.
2. The reduction of carrying charges might not be a high priority; the utility may simply be comfortable with its position or have more pressing problems elsewhere.

Philosophical reasons

Sales of uranium could put downward pressure on the uranium market. Some utilities might consider this to be unfavorable at the current time. A mechanism which might mitigate these concerns is a material trade. In this type of arrangement, the upgrading party would deliver its U_3O_8 to another party, who would in turn replace it with an equal market value of enriched product. This replacement could come from inventory, so that the delivering party would receive both the feed component of its enriched material plus either more U_3O_8 or cash to pay for the SWU.

It may be difficult to find this type of barter partner. It is more likely that an intermediary trading firm would do a back-to-back transaction and thereby become the barter partner for the upgrading party. The intermediary would take the upgrading party's U_3O_8, sell a portion on the spot market to raise cash, and use the cash to purchase conversion and enrichment services for the remaining U_3O_8 feed. This barter upgrading mechanism may offer some advantages to offset the concerns utilities have with selling inventory.

From an economic standpoint, the upgrading transaction would have the following advantages:

1. Upgrading might avoid the capital gains tax if it were viewed as an exchange of like assets.
2. Initially, it would not reduce rate base earnings or AFC earnings, since the same inventory value is in the rate base during the first year. Later, however, inventory would be removed from the rate base at a faster rate.
3. Only part of the excess natural uranium is being "sold", so the fear of high cost replacement/security of supply might be mitigated.
4. Even if the inventory is pledged, or on lease, upgrading would leave it initially with about the same market value, so the exchange should be equally acceptable to creditors and lessors.

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TOPICAL ESSAY

5. Upgrading in today's market takes advantage of price trends in both U_3O_8 and SWU. The upgrading party would reduce its inventory of U_3O_8 where the market price trend is declining, and increase its inventory of SWU, where the market price trend is increasing.

6. Another factor which could make upgrading financially attractive is the current availability of enrichment services at spot prices discounted from the DOE price.

From an institutional standpoint, the following advantages might accrue:

1. Upgrading might receive less attention than an outright sale. In fact, upgrading could be presented in a positive light to management and the PSC as a way of optimizing inventory, not liquidating it.

2. Although inventory management might not receive high priority from the fuel department today, a savings of several million dollars to the treasury department can be demonstrated for many utilities. This might provide the necessary motivation for such an opportunity to receive attention.

The unstable market conditions of recent times have led to complex and creative transactions and inventory management policies such as inventory upgrading. In future essays, Nuexco will discuss other unconventional types of transactions.

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COMMENTARY

FRANCE AND NUCLEAR POWER

France is currently the world's leader among nations developing the use of nuclear power, largely due to the efforts of former President Giscard d'Estaing. However, the recent change in administration may affect the future of the French nuclear program. A new president, Mr. Mitterrand, has been elected and a parliament controlled by his Socialist Party is in place. Approximately two-thirds of Socialist Party members oppose nuclear power. The Communist Party has been awarded four of the 44 cabinet positions in a move to gain their support. The Communist Party strongly supports nuclear power. At issue then is what the various factors and factions will mean to France and nuclear power.

The new president has promised to "bring nuclear power under control" and to place increased emphasis on conservation and non-nuclear alternatives. However, forced to deal within the realities of the French situation, a need for a practical solution may be more important than ideology. Past commitments form a course which cannot be easily changed. How much President Mitterrand wants to change that course, and how much he can change, remains to be seen.

The foremost need of Mitterrand is a consolidation of his political position. He needs a base of political strength from which to carry out the Socialist reforms which are so important to him. A concentration of attention on nuclear power would arouse Conservative opposition and probably would not help his overall aims. Therefore, a downgrading of priority on the nuclear issue is likely.

A national aim has been to eliminate French dependence upon oil for electric power generation. Much progress has been made towards that end. Approximately 20 percent of the power produced this year in France will be from nuclear sources. By 1985, almost 60 percent is planned to be nuclear, and that will increase to 75 percent by 1990. Only three percent of France's electrical power will be derived from oil within ten years.

With this growing reliance upon nuclear power, France's involvement in the worldwide uranium market has expanded. France has become an important consumer of uranium, principally supplied from Niger, Gabon, South Africa and France itself. Its current consumption is approximately seven million pounds per year. The rate will increase to 11 million in 1985, and 18 million in 1990. Diversification of French supply is in progress to some extent. A commitment was made recently to purchase from Australia and there is involvement in exploration and production in the US and Canada.

The French nuclear industry has been almost wholly nationalized for many years. Electricite de France (EdF) is a government owned utility. The nuclear agency of the French government is the Commissariat à l'Energie Atomique (CEA). The CEA owns Cogema, the fully integrated nuclear fuel supplier. CEA also owns 30 percent of Framatome, the nuclear plant supplier. Since nuclear power is already substantially government controlled, further nationalization may have relatively little effect.

President Mitterrand must consider several important matters as he charts France's energy future. Economically, the French need to decrease dependence upon oil has not changed. Nuclear power provides France an energy cost advantage over other members of the European Economic Community. An estimated 150,000 workers in France are employed by the nuclear industry. Politically, France has gained international prestige by its demonstrated ability to take the lead among nuclear nations. A prestigious symbol will not be discarded lightly.

Many factors therefore point to only a moderate change in the course of the French program in the short term. The French nuclear program does have less fundamental political strength than it had before the elections. However, the change may not prove highly significant over the longer pull. Installation of a Socialist government in most other countries has increased business uncertainty and has led to slower economic growth. A slower growth of electricity demand as compared to past estimates is likely. Thus, a slowing of the nuclear program may be a more realistic road to travel.

Thus, French uranium consumption will be virtually unaffected until after 1985. The most likely near term consequence of the new government is a slowing, and possibly complete deferral, of new plant orders resulting in reduced consumption beginning about 1987 or 1988. The net effect might be to lower the rate of French demand in 1990 from 18 million pounds per year to perhaps 15 million. Reduction of worldwide demand would be of the order of three percent should that happen.

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URANIUM RESOURCES REEVALUATED

Introduction

Nuexco completed an evaluation of the Free World's reasonably assured resources (RAR) available at a forward cost below US$25 per pound U_3O_8 in April 1981 (see Nuexco Report 152, page 11). Recent events have caused those evaluation results to further decline primarily for RAR in South Africa and the United States. The downward change in RAR was expected due to rising operating costs and decreasing market prices for uranium concentrate.

The current reevaluation of RAR for the four principal uranium-resource countries of the world—Australia, Canada, South Africa and the US—shows a net 39 percent reduction of uranium availability at a forward cost below US$25 per pound U_3O_8 as compared to the below $50 estimate on page 23 of Nuexco's publication World Uranium Resources, November 1980. Table 4 presents Nuexco's estimate of RAR in the below US$25 per pound category for the four countries, plus an RAR summary for the remaining Free World.

Table 4

SUMMARY OF WORLD URANIUM RESOURCES REASONABLY ASSURED AT FORWARD COSTS BELOW $25 PER POUND U_3O_8

Country	Tonnes U_3O_8 7/1/81	Percent of Total
Australia	415,000	29
Canada	271,000	19
South Africa	242,000	16
US	317,000	22
Subtotal	1,245,000	
Namibia	90,000	6
Niger	72,000	5
Gabon	24,000	2
France	19,000	1
Total	1,450,000	100

Resource Status

United States—A reassessment of US reserves as published in DOE News, May 13, 1981 by the US Department of Energy (DOE) shows a reduction of RAR in all forward cost categories as of January 1, 1981 relative to U_3O_8 recoverable during the mining phase. (No adjustment was made for milling losses.) The most significant reductions occurred in the low unit-cost categories below $30. Available RAR in the below $15 category was reduced 50 percent—from 204,040 tonnes U_3O_8 in January 1980 to 102,000 tonnes in January 1981. DOE estimates the remaining tonnage at an average grade of 0.21 percent contained U_3O_8, all of which is considered available only in developed mines. Even so, actual recovery will depend on selective mining of higher grade ore in most operations. This in turn would potentially reduce the overall tonnage available in the below $15 category and jeopardize the eventual recovery of ores in the categories above $15. High-grading an orebody offers only temporary advantages—mostly economic; actually, it would further reduce RAR in all cost categories.

The 102,000 tonnes dropped from the below $15 category is considered to occur in undeveloped deposits and is therefore available as higher grade ore in the $15 to $30 category. Total RAR in the cost category up to $30 is estimated by DOE at 426,000 tonnes U_3O_8, down from 585,000 tonnes in 1980. However, only 317,000 tonnes are estimated by Nuexco to be RAR at the market level of $25 per pound U_3O_8. It represents a decrease of 46 percent from the January 1980 estimate by DOE at $30 per pound U_3O_8. It is espected that the total RAR considered available to the uranium industry today will continue to be downgraded for as long as the present downward market price trend continues, particularly in terms of real dollars. Table 4 lists Nuexco's estimate of RAR in the US at below $25 per pound U_3O_8.

South Africa—The Atomic Energy Board (AEB) of South Africa recently announced that all uranium resources had been reassessed to conform with the classification system recommended by the International Atomic Energy Agency (IAEA). The result was a sizeable reduction of RAR in the US$30 and $50 forward cost categories. The greatest reduction occurred in the below $30 category where essentially all RAR occurs in association with gold in the quartz-pebble conglomerates of the Witwatersrand system. The new estimate of RAR considered available in conglomerates is 243,000 tonnes U_3O_8 compared to the 364,000 tonnes estimated by Nuexco in World Uranium Resources, November 1980, page 1. Cost consideration for uranium in the conglomerates is more sensitive to market conditions for gold than

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uranium. The reduction of RAR for uranium reflects the depressed nature of the current gold market.

Other RAR in South Africa includes 41,000 tonnes U_3O_8 in gold tailings of the Witwatersrand district, about 3,500 tonnes in sediment of the Karoo Basin, and another 3,500 tonnes in association with copper ores in carbonatite at Palabora. RAR in the Karoo sediments are susceptible to additional reductions, if not complete elimination, as undeveloped resources in the present uranium market. Uranium in the tailings must be considered recoverable as a co-product to gold, otherwise it does not fit the RAR classification. At Palabora, the by-product recovery of uranium is directly affected by copper recovery operations.

Total RAR in all geologic environments of South Africa according to the estimate by the AEB are 291,000 tonnes U_3O_8 a decrease of 29 percent below an AEB estimate of September 1978. Mining and metallurgical losses have been factored into the final figure. The Nuexco estimate of RAR in the below $25 forward cost category is 242,000 tonnes U_3O_8 of which approximately 89 percent occurs within the Witwatersrand Basin. Nuexco's estimate is 17 percent below the current estimate at below $30 by the AEB.

Australia—Unofficially, uranium resources have grown in Australia. Energy Resources of Australia (ERA) announced on May 27 that geologic reserves on the Ranger No. 3 Orebody had increased approximately 14,000 tonnes contained U_3O_8, from 58,000 tones U_3O_8 to 72,000 tonnes, at an average grade of 0.188 percent U_3O_8. According to the ERA announcement the new reserves were located by the diamond drilling on the eastern segment of the orebody. Excellent potential remains to expand reserves by additional drilling in the northeast and southwest quadrants of the mineralized zones.

The new reserves are classified by Nuexco as RAR due to the favorable grade of the material and the fact that the Ranger project is under development with construction of the mine and mill progressing rapidly. (The Ranger No. 1 Orebody is being developed; No. 3 Orebody will be developed at a later date.) Total RAR for the Ranger project is 125,000 tonnes U_3O_8 of which 53,000 tonnes U_3O_8 is known to occur in the No. 1 Orebody at an average grade of 0.33 percent U_3O_8.

Nuexco's estimate of RAR for Australia at a forward cost below $25 is upgraded to 415,000 tonnes U_3O_8. It includes in addition to Ranger, the RAR of Jabiluka, Koongarra, Yeelirrie, and Mary Kathleen. The increase is only three percent above previous Nuexco estimates, however, it is significant that 363,000 tonnes (88 percent) of the total RAR occurs in high-grade deposits located in the Northern Territory. The potential to increase RAR in the Northern Territory by extensions of known deposits and/or new exploration is excellent. The status of the remaining 52,000 tonnes U_3O_8 in the below $25 category is less certain. Further decline in the market value of U_3O_8 and continued high operating costs could force the Mary Kathleen operation to cease operations and reduce the RAR by 6,000 tonnes. The same circumstances may delay indefinitely the development of the Yeelirrie deposit in Western Australia. In that case, 46,000 tonnes U_3O_8 would be reclassified into a higher forward cost category.

Canada—Uranium resources of Canada are assessed each year by the Department of Energy Mines & Resources (EMR). Their classification of measured and indicated resources is equivalent to the RAR classification by the IAEA. However, the resources are based upon quantities of uranium ore minable in forward cost categories of up to US$50 per pound.

The last official estimate covers RAR through the end of 1979. In Report EP 80-3, Uranium in Canada, 1979 Assessment of Supply and Requirements, the EMR lists RAR at 271,000 tonnes U_3O_8 at a forward cost below $50. It represents an increase of almost 17 percent above the 1978 figure, most of which is credited to further evaluation of the Key Lake deposit located in northern Saskatchewan. EMR estimates that almost 90 percent of RAR are associated with deposits that are now in production or committed for production.

The Nuexco estimate of RAR at a forward cost below $25 in Canada corresponds to the EMR estimate of 271,000 tonnes at costs below $50. There is no downward adjustment by Nuexco because all RAR are included in operating mines or are part of the high-grade deposits in northern Saskatchewan. In this circumstance, the resources are considered to remain available even at a forward cost of $25. Nuexco considers approximately 39 percent or 105,000 tonnes U_3O_8 of all RAR, to be located in four deposits of the Saskatchewan district—Cluff Lake = 18,000 tonnes, Key Lake = 70,000 tonnes, Rabbit Lake = 10,000 tonnes and Eldorado = 7,000 tonnes. Of the

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remaining 166,000 tonnes, about 161,000 are located in the Elliot Lake district of Ontario; the remaining 5,000 tonnes are located in small deposits throughout Canada.

The ratio of RAR distribution will probably change in the near future. The reclassification of resources into the RAR category for several large high-grade deposits in northern Saskatchewan is pending completion of late-stage evaluation work. Final evaluation of deposits at Collins Bay A & B, Midwest Lake, Horseshoe and Raven, McClean Lake, and Maurice Bay could increase RAR by another 140,000 to 180,000 tonnes U_3O_8. The total increase is not imminent—each project is at a different stage of evaluation. However, the addition of RAR at the Collins Bay A & B deposits and the Midwest Lake deposit could be included in the next estimate by EMR. The remaining deposits may not be reclassified as RAR for several more years.

Table 4 lists Nuexco estimates of RAR recoverable at a forward cost below US$25 per pound U_3O_8 for Australia, Canada, South Africa and the US. RAR for the rest of the Free World remains unchanged from Nuexco Report 152, April 1981. The percentage of RAR per country as compared to the world total is also listed.

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STATISTICAL DATA

EXCHANGE VALUE $24.25/lb. U_3O_8
Determined as of June 30, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:
A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:
A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of June 30, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
24.50	2.9	10	6

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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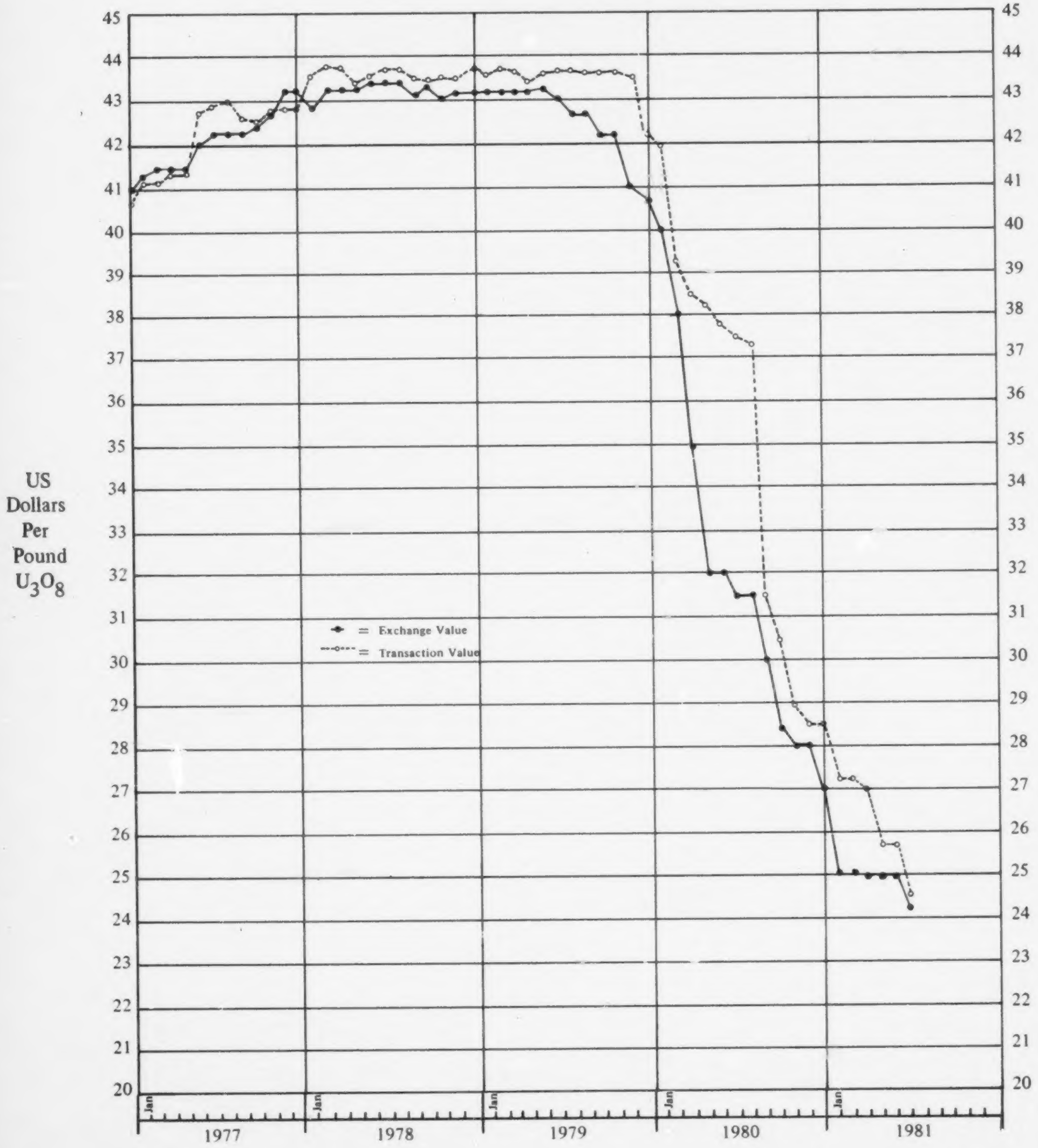
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25						

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50						

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	24.25	53.46	63.04
France (franc)	138.10	304.45	359.02
FRG (mark)	57.95	127.75	150.64
Japan (jen)	5,484	12,090	14,257
Switzerland (franc)	49.33	108.75	128.24
UK (pound)	12.45	27.45	32.37
Australia (dollar)	21.12	46.56	54.91
Canada (dollar)	29.09	64.13	75.63
Niger, Gabon (CFA)	6,905	15,223	17,951
South Africa (rand)	21.38	47.12	55.57
Sweden (Kröner)	123.47	272.21	321.00

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

CONVERSION VALUE $1.15/lb. U as UF_6
Determined as of June 30, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and/or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:
A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:
A. The price of conversion services delivered or to be delivered under old contracts.
B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

UF_6 VALUE $65.90/kg. U as UF_6

Definition

The UF_6 Value is the price of a kilogram of U as UF_6 based on the Exchange Value and the Conversion Value, and assuming one-half percent conversion loss.

LOAN USE CHARGE RATE 5-1/2%
Determined as of June 30, 1981

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:
A. Data from recently completed or pending loan transactions.
B. Rates included in firm proposals to borrow or lend.
C. Rates that potential borrowers and lenders have expressed as a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1539	81–91	301–600	–	US	US	Price is market related
1544	81	101–300	–	US	US	Loan
1547	81	301–600	99	US	US	
1548	81	301–600	99	US	US	

Conversion Transactions

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*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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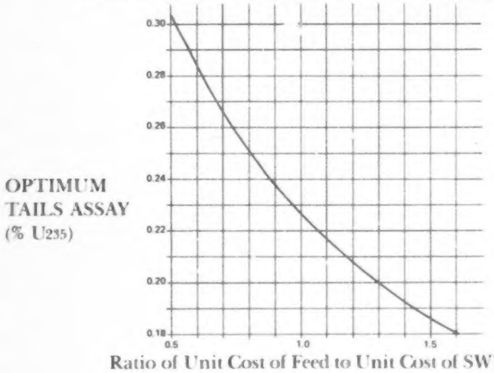
STATISTICAL DATA

OPTIMUM TAILS ASSAY

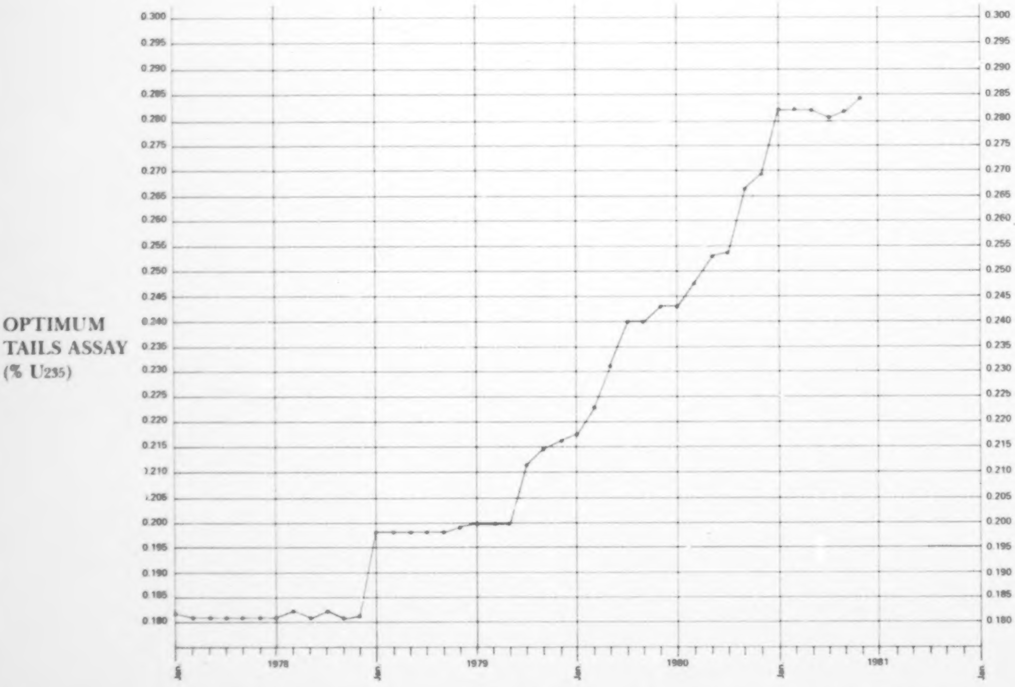
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
Ann. Avg. 1970(5)(7)	110.0	116.3	91.36	3.88	3.87	3.69	3.28
Ann. Avg. 1971(5)(7)	114.1	121.3	96.02	4.12	4.15	3.97	3.49
Ann. Avg. 1972(5)(7)	117.9	125.3	100.00	4.56	4.59	4.26	3.71
Ann. Avg. 1973(5)(7)	125.9	133.1	105.80	4.84	4.98	4.51	3.91
Ann. Avg. 1974(5)(7)	153.8	147.7	116.02	5.44	5.63	4.88	4.21
Ann. Avg. 1975(5)(7)	171.5	161.2	127.15	6.13	6.24	5.39	4.64
Ann. Avg. 1976(5)(7)	182.4	170.5	133.71	6.76	6.87	5.91	4.96
Ann. Avg. 1977(5)(6)(7)	195.1	181.5	141.70	7.28	7.67	6.43	5.39
Ann. Avg. 1978(5)(6)(7)	209.4	195.4	152.05	8.23	8.56	7.02	5.82
Ann. Avg. 1979(6)(7)	236.5	217.4	165.46	9.27	9.49	7.60	6.32
Ann. Avg. 1980	274.5	246.8	177.36	10.26	10.61	8.29	6.96
Feb 1980	265.9	236.4	–	9.92	10.01	8.01	6.71
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05	6.78
Apr 1980	271.3	242.5	–	10.00	10.30	8.12	6.79
May 1980	271.9	244.9	–	10.18	10.37	8.17	6.78
Jun 1980	273.5	247.6	178.93	10.13	10.69	8.24	6.87
Jul 1980	276.2	247.8	–	10.24	10.82	8.35	6.96
Aug 1980	278.2	249.4	–	10.38	10.78	8.39	7.02
Sep 1980	278.8	251.7	182.92	10.54	10.94	8.46	7.14
Oct 1980	282.2	253.9	–	10.58	11.00	8.52	7.20
Nov 1980	283.4	256.2	–	10.73	11.06	8.59	7.29
Dec 1980	286.6	258.4	183.98	10.86	11.31	8.68	7.39
Jan 1981	291.2R	260.5	–	10.93	11.30	8.73	7.42
Feb 1981	294.8	263.2	–	11.16	11.35	8.79	7.45
Mar 1981	298.9	265.1	187.30	11.14	11.49	8.84	7.49
Apr 1981	302.8	266.8	–	11.26 P	11.64P	8.91P	7.52P
May 1981	304.1P	269.0P	–	–	–	8.96P	7.56P

P = Preliminary   R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Monthly data 1970-1978 for Price Indexes and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Monthly data 1977-1979 for Employment and Earnings SIC codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.

(7) Monthly data 1970-1979 for Employment and Earnings SIC code 36 appear on page 23 of Nuexco Report 154.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	198.5	190.04
Annual Avg. 1979	248.8	196.34
Annual Avg. 1980	321.7	217.75R
Feb 1980	345.6	215.20
Mar 1980	340.3	214.83
Apr 1980	327.9	214.14R
May 1980	335.1	214.81
Jun 1980	338.4	214.14
Jul 1980	349.1	221.44
Aug 1980	353.2	219.95
Sep 1980	351.6	219.45
Oct 1980	349.5R	220.73
Nov 1980	351.7R	221.10
Dec 1980	353.0	221.43
Jan 1981	359.1	228.30
Feb 1981	358.0	228.12
Mar 1981	356.6	227.34
Apr 1981	355.7P	227.05P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra: "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	**Primary Metal Industries, non-ferrous (SIC 296-298)**	**Chemicals and Chemical Products (SIC 370-379)**
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Annual Avg. 1980	247.2R	10.59	8.05	8.50
Feb 1980	240.8	10.11	7.69	8.08
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.4	10.58	8.14	8.65
Sep 1980	252.0	10.85	8.24	8.71
Oct 1980	256.0	11.05	8.28	8.82
Nov 1980	257.7	11.11	8.38	8.77
Dec 1980	258.3	11.13	8.32	8.92
Jan 1981	263.1R	11.27	8.51	8.90
Feb 1981	263.3R	11.43P	8.60P	8.99P
Mar 1981	265.2	11.39P	8.61P	9.14P
Apr 1981	267.0P	–	–	–

P = Preliminary R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.
(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.
(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.
(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)
Annual Avg. 1970(3)	7.34	100.3(4)	
Annual Avg. 1971 (3)	7.88	106.4(4)	59.1
Annual Avg. 1972 (3)	8.79	113.3(4)	63.9
Annual Avg. 1973 (3)	10.51	124.1(4)	72.3
Annual Avg. 1974 (3)	13.18	138.5(4)	85.3
Annual Avg. 1975 (3)	16.71	157.2(4)	100.0
Annual Avg. 1976 (3)	19.30	174.7(4)	115.1
Annual Avg. 1977 (3)	23.87	194.4(4)	130.0
Annual Avg. 1978 (3)	27.14	137.2	142.7
Annual Avg. 1979 (3)	30.18	155.3	164.5
Annual Avg. 1980	35.53	176.7	192.1
Feb 1980	–	167.0	180.5
Mar 1980	33.65	168.0	181.7
Apr 1980	–	170.0	184.2
May 1980	–	171.9	187.0
Jun 1980	34.48	174.6	189.0
Jul 1980	–	177.2	192.7
Aug 1980	–	179.2	196.8
Sep 1980	36.19	182.8	199.8
Oct 1980	–	186.3	203.1
Nov 1980	–	187.8	205.6
Dec 1980	37.69	189.9	206.5
Jan 1981	–	191.0	207.2
Feb 1981	–	193.8	209.8
Mar 1981	39.26	195.2	209.9
Apr 1981	–	196.4	211.6
May 1981	–	197.7	–

(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.

(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."

(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Nuexco Report 140.

(4) April 1970 = 100.00.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1392	400			
1393			350	
1475	1250			UF_6
1480	300	300	300	
1540	300	750		UF_6
1550	600			
1552	200			
1562			150	Long term
1575		500	500	Long term
1576	250			
1581	100	150	150	Long term
1595	600	600	800	
1600			200	Long term
1630	500			UF_6
1637	500	500		
1678		275		
1685	100			
1698	100			
TOTAL	5200	3075	2450	
Available for Loan:				
1429	300			UF_6
1602	400			
1646	275	275	275	
1671-	300			
1695	225	325	325	UF_6
TOTAL	1500	600	600	

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1423	1000	1000		
1459			200	Long term
1462			100	Long term
1514		400		
1529			550	Long term
1603		100	100	Long term
1634		400	400	
TOTAL	1000	1900	1350	
Inquiries to Borrow:				
1621	300			
1686	200			
1699	225	1000		
TOTAL	725	1000		

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1451	75			
1609	1000	900	1000	
1619		200	100	
1630	400			
1661		400	400	Long term
TOTAL	1475	1500	1500	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1594		400	950	Long term
1622		400	400	Long term
1626	75			
1688	1300			
1689	150	300	300	Long term
TOTAL	1525	1100	1650	

*Measured from the date of this Report.

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AUGUST 1981 NUMBER 156

Monthly Report on the Uranium Market

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MONTHLY REPORT ON THE URANIUM MARKET

August 1981 No. 156

JAMES E. VAUGHAN, *EDITOR* TERESA T. ELMS, *ASSOCIATE EDITOR*

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FORWARD

Nuexco will be hosting a hospitality suite during the Atomic Industrial Forum, Inc. Canadian Nuclear Association "International Conference on Uranium." The suite will be at the Loews Le Concorde in Quebec City, Canada, September 15-18, 1981.

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URANIUM MARKET

AFRICA

South African production figures of gold-uranium operations for the second quarter 1981 have recently been released and are as follows:

Table 1
SOUTH AFRICAN GOLD-URANIUM PRODUCTION SECOND QUARTER 1981

Operation	Pounds U_3O_8 Produced
Blyvoorvitzicht	187,646
Buffelsfontein	361,900
CHEMWES	362,540
ERGO	180,320
Harmony	322,504
Hartebeestfontein[1]	268,534
J.M.S.	582,905
Randfontein	324,117
Vaal Reefs[2]	921,360
West Dreifontein	130,728
West Rand Consolidated	178,226
Western Deep Levels	129,406
Total	3,950,190

(1) The reclamation and treatment of accummulated uranium bearing slimes remains suspended in order to limit cash invested in stockpiled U_3O_8. Forward sales commitments will be fulfilled by production from the currently milled ore.

(2) Due to delays in the uranium section of the Afrikander Lease area plant, Vaal Reefs has announced that this portion of the plant will not be commissioned until the second quarter, 1982. There was no uranium production from Afrikander Lease in the second quarter, 1981, as the tonnage mined was stockpiled in anticipation of commissioning of the uranium plant in 1982.

West Rand Consolidated Mines Ltd. announced recently that its uranium production will be stopped as soon as practical because of economic considerations. The production of gold at the mine will continue. Increased development of the mine showed sufficient gold reserves to justify gold output only.

Despite current market conditions, other South African uranium production efforts are continuing. The construction of Western Area's uranium plant is proceeding and commissioning is anticipated before 1981 year end.

Additionally, Beisa Mines Ltd. No. 1 shaft reached its final depth of 1071 meters and shaft installation and equipping has begun. About 1826 meters of underground development were completed during the second quarter. The construction of the uranium and gold extraction plants is virtually complete and commissioning is in progress.

AUSTRALIA

Pancontinental Mining Ltd. and other mining companies have received a boost from the Aboriginal Land Commissioner's report on aboriginal land claims in the Northern Territory. The report rejected 90 percent of the claims in the Alligator River area, a positive sign for the producers interested in exploration and development there. The recommendations contained in the report still must be ratified by the federal government. Claims by four aboriginal clans for land including the Jabiluka uranium deposit resulted in a recommendation for the land to be granted to a land trust.

Compensation arrangements with the traditional owners in the area are now moving forward. Pancon will make payments of A$16 million over a ten year period with most of the money going to the Northern Land Council for use in various aboriginal projects and facilities.

Pancon has decided to raise A$22 million by making a one-for-one share issue. This move reflects the current strained cash situation of the company. However, it also displays confidence in obtaining government approval for the Jabiluka project. The funds raised will be used to finance what is becoming a a broadly based exploration effort. The company's exploration budget is running at about A$3 million per year including funds for exploration for base metals and other minerals.

Uranium production plans by Pancon call for an initial mining production of 6.6 million pounds U_3O_8 per year. Design milling capacity will be ten million pounds U_3O_8 per year. The company believes that project approval by the government is imminent. Agreements with aboriginal groups are expected by the end of September, 1981. Also still to be settled is the Unless an exemption is granted, Getty must reduce its interest from 35 to a maximum of 25 percent to rearrangement of equity holding with Getty Oil Co.

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conform to Australian foreign investment standards in uranium mines.

CANADA

Eldorado Nuclear Ltd. received approval last month for construction of a new uranium trioxide refinery in Blind River, Ontario. The proposed refinery satisfactorily passed evaluation by the Atomic Energy Control Board (AECB) and various health and safety ministries and agencies. Eldorado will still be required to apply for a license from the AECB before the plant can be put into operation.

The AECB also gave site approval to Eldorado's proposed expansion of its uranium hexafluoride conversion facilities at Port Hope, Ontario. Eldorado recently received a directive to upgrade Port Hope's current monitoring and control programs for airborne emissions. A construction license for the expansion would be contingent on these same improvements.

The topic of conversation in Canadian uranium circles lately revolves around the charges brought against six companies under the Combines Investigation Act. The essence of the charges is that the cartel of the early 1970's, in addition to affecting international prices, also caused Canadian consumers, specifically Ontario Hydro, to pay more for uranium than they would have otherwise. A Nuexco Topical Report was published in October 1976, covering the multitude of reasons for the rapid price increase in the mid-1970's.

FAR EAST

A special advisory committee on nuclear power to Japan's Ministry of International Trade and Industry (MITI) has submitted its policy recommendations for future Japanese energy security. A similar report was last issued in 1978.

The report must be viewed in relation to the Japanese government's previously announced nuclear generation target of 51,000 to 53,000 MWe installed capacity by 1990 and 74,000 to 78,000 MWe by 1995. Assuming such objectives can be achieved, the report indicates that Japan's current "long" uranium position may become a short position in the early 1990's. Important points of the report related to uranium supply are:

1. Japanese utilities currently have scheduled approximately 196,000 short tons of U_3O_8 for future delivery under long-term contracts (See Nuexco Monthly Report 154, June 1981).
2. Additional commitments of 130,000 short tons of U_3O_8 are forecast to be needed for the period 1990-2000.
3. Less than 20 percent of existing uranium supply commitments comes from participation in overseas production. The remaining commitments are from conventional long-term contracts with producers. The report encourages greater participation in independent or joint venture developments overseas.
4. Current procurement is concentrated in a limited number of geographical areas. The MITI report recommends further diversification with reliable suppliers.
5. The report recommends closer cooperation between Japan's utilities and other Japanese companies in joint procurement and development ventures overseas.
6. Because of Japan's complete dependence on foreign uranium supply, the report suggests that consideration be given to actual stockpiling of uranium in Japan. A minimum of one year's supply is recommended. Examples of previous supply interruption due to embargoes and transportation strikes are cited as evidence of such a stockpile need.

As noted earlier, the above recommendations are based on the government's officially announced objectives for nuclear generation for 1990 and 1995. Nuexco, in a *Topical Essay* "Japan's Nuclear Growth: Hope vs. Reality" (Nuexco Monthly Report 153, May 1981), reviewed the realities of achieving such goals. It was noted that 40,000 MWe of installed nuclear generation by 1990 would be a noteworthy performance and would be possible only under very favorable circumstances.

Related topics in the MITI report indicate that the Japanese nuclear program is indeed moving forward and that Japan should be classified as one of the more active nuclear markets in the world. Although the report could be viewed as encouraging new long-term procurement moves by Japanese utilities, some degree of caution in evaluating these latest policy recommendations is needed particularly as it becomes more apparent that the official 1990 target is unlikely to be met. One possible result may be an effort to implement

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the stockpiling recommendations. Since the principle motivation behind this suggestion appears to be security of supply, it seems logical that any stockpiling in Japan would be in the form of enriched product.

In mid-July Tokyo Electric Power Company (TEPCO) officially announced the placing of contracts for two additional 1100 MWe Boiling Water Reactors (BWR's). Kashiwayaki Unit 2 was awarded to Toshiba and Kashiwayaki Unit 5 was awarded to Hitachi. Both units are scheduled for operation in the late 1980's. With these two commitments, TEPCO's nuclear program totals approximately 12,400 MWe. This figure covers plants operating, under construction and those firmly on order.

A breakdown of this figure includes the Fukushima I site which contains six operating units with a capacity of 4700 MWe, and the Fukushima II site which has four units with a capacity of 4400 MWe. One of the Fukushima II units is undergoing power tests and the remaining three are scheduled for operation prior to 1986.

Also included is the Kashiwayaki site which consists of two areas. Units 1 through 4 are located in one section, and Units 5 and 6 and possibly Unit 7 are in the other. With Unit 1 scheduled to start, construction of Units 2 and 3 in order would result in excessive congestion in the narrow site. Thus TEPCO jumped to the second area and contracted for Unit 5 at the same time as Unit 2 as noted above. Units 3, 4, 6 and 7 have not yet been ordered. Units 1, 2 and 5 have a combined capacity of 3300 MWe.

The Japanese Agency of Natural Resources and Energy of MITI studied the comparative costs of electric generation in Japan. The results are presented in Table 2.

UNITED STATES

This past month again saw producers reacting to the uranium market slump with decisions to cut back or halt production. At the same time, there were a few announcements of resumptions or start-ups of production facilities.

Ranchers Exploration Corp. announced that it is closing its Hope Mine operation near Grants, New Mexico. In the fiscal year ending June 1980, the facility produced 93,000 pounds U_3O_8.

Further cutbacks were announced by Petrotomics Co. at its Shirley Basin, Wyoming mill. The mill's uranium processing will be cut to about 750 tons per day beginning August 1. Approximately one-third of the Shirley Basin mine's work force (130 workers) were laid off in March, 1981.

Union Carbide Corp., however, will resume operations at its Uravan, Colorado mill in September. The mill has a 1,200 ton per day capacity. Activity there has been stopped since March 1, 1981 because firm contract requirements could be met with only six months production.

Also moving forward is Ogle Petroleum's in-situ uranium project at Bison Basin, Wyoming. Ogle plans to begin commercial operation of the facility in mid-August.

Table 2
COMPARATIVE COSTS OF ELECTRIC GENERATION IN JAPAN

Type of Generation	1981 Delivered Cost US ¢/kwhe	Average Construction Cost of Plant Starting Operation in 1981 US $/KWe	Estimated Construction Cost of Plants Scheduled for 1985 Startup US $/KWe	1981 Fuel Cost as % of Generation Cost
Nuclear	4.8—5.3	1,066—1,111	1,422—1,466	25
Imported Coal	6.2—6.6	800—850	1,066—1,111	55
Liquified Natural Gas	7.5—8	622—666	755—800	75
Conventional Hydro	8—8.5	2,400—2,511	2,933—2,977	0
Oil	8.5—9	488—533	711—755	80

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TRANSACTIONS

There are three uranium transactions reported this month. The first involved the sale of between 100 thousand and 300 thousand pounds U_3O_8 from a US utility to a US producer, with delivery to take place later this year. The second was a sale of between 100,000 and 300,000 pounds U_3O_8 from a US seller to a Far East utility. Delivery is scheduled for late this year. The last transaction was a sale of between 300,000 and 600,000 pounds U_3O_8 equivalent from a US seller to a Far East utility for delivery late this year. The latter two transactions are related to each other and involve a trading company. The complex nature of the transactions makes it impractical to tabulate the approximate price on the Current Transactions page of this Report.

There are two conversion transactions reported this month. The first was a sale of between one million and two million pounds U of conversion between two US utilities, with delivery taking place between 1983 and 1985. The second sale was from a US utility to a non-US user. Between 300 thousand and 600 thousand pounds U for immediate delivery were involved.

PRICING

The **Exchange Value** decreased again this month to $23.50, from $24.25 the previous month. The major driving forces for the change are as follows:

1. During the month a new buyer entered the market for a substantial near-term purchase. Spirited competition developed among several sellers in an effort to obtain this business, thus putting renewed downward pressure on the market. The buyer is now in serious negotiations with the successful sellers to close this transaction.

2. The unsuccessful sellers indicated a willingness to sell at prices less than the previous month's Exchange Value. These sellers continue to offer material at prices about the level of this month's Exchange Value.

3. The near-term market continues to be imbalanced, as indicated in the *Market Opportunities* section of this Report. Material available for sale amounts to about 5.4 million pounds U_3O_8, while near-term inquiries to purchase total 1.4 million pounds. The numbers indicate a narrowing of the supply-demand gap over the past few months. This is principally because several significant near-term transactions have closed recently, and others are in serious negotiation. It is apparent that as new buyers enter the market, they attract considerable competition among sellers, thus further eroding prices. About two-thirds of the material currently available for sale in the near term is being offered by inventory holders. Some inventory holders have become most aggressive in their roles as sellers.

The **Transaction Value** decreased slightly to $21.40 per pound U_3O_8. The ten qualifying transactions took place over the last five months when prices were fairly steady. The total amount of material considered in this month's Transaction Value was 2.9 million pounds.

The uranium loan market is continuing to attract interest from potential borrowers and lenders. The **Loan Use Charge Rate** remained at the previous month's level of 5½ percent.

CONVERSION

The **Conversion Value** remained at $1.15 per pound U for the third straight month. Two secondary market transactions closed this month. One was an intermediate term sale at prices close to the Conversion Value. The other was a near-term sale at prices less than the Conversion Value. The latter was a *deconversion* transaction whereby a uranium inventory holder had entered into a sales agreement conditioned on the seller's making a deconversion swap. This was necessary because the seller's inventory was in the form of UF_6 and the uranium buyer required material in the form of concentrates.

The deconversion swap has proved to be a useful device for many reasons. From the standpoint of the UF_6 holder:

1. The uranium is often more readily salable in the form of concentrates.

2. Concentrates are easier and cheaper to store.

3. Purchase of UF_6 cylinders would be obviated.

4. The UF_6 holder may wish to obtain concentrates to fulfill another conversion obligation.

From the standpoint of the concentrates holder, the major advantage to the deconversion swap is that the material can be upgraded to UF_6 usually at a small percentage of the price normally paid to primary conversion contractors for this service.

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URANIUM MARKET

As indicated in the *Market Opportunities* section of this Report, the total of secondary market conversion services available for near-term sale is about 2.3 million pounds U. Total near-term demand is about one million pounds U.

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TOPICAL ESSAY

UNCONVENTIONAL TRANSACTIONS: PART II, OPTIONS

As uranium prices continue to decline, market participants are expressing more interest in pursuing unusual transactions to offset the uncertainty of future price developments. In Nuexco Report 155, one such technique, that of inventory upgrading, was discussed. In this essay another tool, the option, will be examined.

On Wall Street, the option is an established and accepted market tool. In the uranium industry it has been limited primarily to option clauses attached to sales contracts. Recently, though, there has been an upsurge in interest in the straight purchase of options.

Option Candidates

The most likely candidate to *purchase* an option to buy uranium would be a producer who has both existing delivery contracts and production costs at or above the current market price. This producer will probably already be contemplating shutting down existing production facilities or discontinuing plans to bring new production on line. However, the producer may not wish to commit to any irreversible action such as a direct purchase.

The most likely candidate to *sell* an option would be a utility with significant excess uranium inventory. Alternately, any uranium producer with uncommitted production might be interested in selling an option.

Advantages

While some of the advantages of buying an option also apply to the outright purchase of material, and more specifically the potential economic advantage of purchasing rather than producing (see the *Topical Essay* in Nuexco Report 144, "Produce or Procure: The Uranium Version of Make Vs. Buy"), the additional element which the option buyer gains is flexibility. With an option, the producer can safely make plans to cut back on production while watching for market developments. If the price goes up significantly, it may not be necessary to shut down existing production. If the price goes up slightly or holds steady, the producer would have an in-place contract to fill its needs at or below market price value. If, on the other hand, the market price goes down, the producer can purchase the material elsewhere and allow the option to expire.

The option flexibility allows a producer to make the decision to curtail production immediately without concern about filling near term contractual commit-

Table 3

EXAMPLE OF CALCULATION OF EXPECTED SAVINGS FOR A PURCHASER OF AN OPTION

Option Exercise Price ($/lb. U_3O_8)	Market Price in One Year ($/lb. U_3O_8)	Value of Option ($/lb. U_3O_8)	Probability of Market Price	Expected Value ($/lb. U_3O_8)
23.50	25.50	2.00	1/6	0.333
23.50	24.50	1.00	1/6	0.167
23.50	23.50	0.00	1/3	0.000
23.50	22.50	0.00	1/6	0.000
23.50	21.50	0.00	1/6	0.000

Total Expected Value of Savings Due to Purchase of Option:	0.500
Less Option Price:	(0.25)
Net Expected Savings:	0.25
For One Million Pound Option, Total Expected Savings:	$250,000

Assumptions:
A. Option Price is $0.25/lb. U_3O_8.
B. Option Exercise Price is $23.50/lb. U_3O_8
C. Option Term is one year.
D. Option is exercised at the end of the one year term.

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TOPICAL ESSAY

ments with high priced material. An option eliminates the risk of exposure in selling short in a rising market.

To the seller of an option, the advantages are basically two-fold. In the case of a utility with excess inventory, an option can produce revenue from otherwise idle assets. For many utilities this is an attractive prospect, especially as there may be management or regulatory pressure to justify a large inventory. Secondly, by selling an option there is some chance that the seller of the option will have established a market for the material. Given the current nature of the market and the difficulty in selling material, particularly in large quantities, this will be a major driving force in dealing in options.

To quantify the value of an option, Table 3 lays out an example of an expected value calculation for the purchaser of an option. (A similar calculation can be performed for the seller of an option.) For purposes of this example, the option is assumed to have a term of one year at an Option Price of \$0.25/lb. U_3O_8 and an Option Exercise Price of \$23.50/lb. U_3O_8. Qualitative considerations such as the additional flexibility that a producer may gain from buying an option or the easing of pressure from upper management or the Public Utility Commissions that a utility might get from selling an option are difficult to assess but are additional benefits of an option.

An option not only gives freedom of operational action not available in a straight sale, but flexibility in contractual terms as well. Not only are all the exercise terms negotiable, but the option terms are quite variable also. The major option terms which must be agreed upon are:

1. Option Exercise Price: At what price level will the option to purchase and sell be exercised?
2. The Option Price: What will the purchaser of the option pay the seller in consideration for the option? Is this price credited towards the exercise price in the event that the option is exercised?
3. Term: For how long will the option be effective? Does the buyer have the right to extend the option under similar conditions for additional periods?
4. Prior Sale: Does the seller of the option have the right to sell the material during the Term if the buyer of the option is given a right of first refusal? How long does the buyer have to make this decision? This is an extremely important item, for it will determine whether the seller of the option must take the material out of the market for the Term of the option contract.

Thus the overall attractiveness of an option to both buyer and seller lies in the increased flexibility it permits—flexibility in operations management, inventory handling, and in the conditions under which a sale will take place. Under the uncertain market conditions that currently prevail, it is the need for such flexibility that has sparked interest in unusual transactions such as the option.

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ESSAY

NUCLEAR AGREEMENTS UPDATE

Introduction

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT), entered into force in 1970, was intended to prevent the spread of nuclear weapons by allowing regulated transfer and use of nuclear materials and technology under the scrutiny of the International Atomic Energy Agency (IAEA). In addition to the NPT, several uranium producing nations established nonproliferation policies with conditions even more restrictive than the NPT. An update on the bilateral nuclear agreements of the US, Canada and Australia is included in this essay, along with a look at nuclear policy in those three countries.

US

In the US, the safeguards policy of the Carter Administration resulted in the passage of the Nuclear Non-Proliferation Act (NNPA) in 1978. The NNPA revised US policy regarding safeguards agreements, the exportation of natural and enriched uranium, nuclear equipment and technology and the reprocessing, recycling and retransfer of US uranium and plutonium. Under the act, the US unilaterally claimed broad rights of approval and tight controls on the transfer and reprocessing of US supplied nuclear material. The NNPA set criteria and procedures for negotiating agreements for cooperation (bilateral or multilateral) with other nations to reflect the changes in policy. The act also called for an upgrading of existing agreements to conform to the new standards.

The process of negotiation in the US takes place as follows. The State Department negotiates the bilateral agreements with technical assistance from the Department of Energy and with advice from the Director of the Strategic Arms and Disarmament Agency. The completed document is then sent to the President. The President has comments from the Nuclear Regulatory Commission (NRC) available to him as well. Following Presidential approval, the agreement is transmitted to Congress. Congress has 60 days to overturn the President's decision. Unlike treaties, the agreement does not require ratification. After Congressional review, the two countries formally communicate mutual acceptance. The agreement then enters into force.

In an effort to upgrade existing US agreements, there have been preliminary rounds of renegotiation talks with many countries. Renegotiation talks have been completed and revised agreements entered into force with Australia, Canada and the IAEA.

Since the passage of the NNPA, only one completely new agreement, with Morocco, has been negotiated, signed and entered into force. Negotiations for new agreements with Bangledesh, Peru and Egypt have all been completed and are expected to enter into force this year. An agreement with Bangledesh has been approved by President Reagan and is expected to be signed in Bangledesh soon. The Egyptian agreement was signed by Reagan and is now before Congress for review.

Some of the countries with which renegotiations are well along include Colombia, Indonesia, Norway, Finland and Sweden. Negotiations with Colombia have been completed but the agreement has not yet entered into force. The agreement with Indonesia is in a similar stage. Renegotiation talks have been completed but the agreement has not yet entered into force pending ratification by the Indonesian legislature.

Finalization of a revised agreement with Norway is pending. The agreement is still within the US Executive Branch although the renegotiations have been completed and the text has been initialled. The final revision is expected to go to President Reagan soon. The bilateral agreement with Finland is fairly far along the renegotiation chain although outstanding issues remain.

The existing US agreement with Sweden does not expire until September 1996, however, negotiations to bring it in line with the NNPA are underway. Initial agreement on the text is still pending. The issue of reprocessing is a major stumbling block. It currently is not possible for the US to export uranium to Sweden because Swedish law requires that spent fuel be reprocessed. Under US law, a guarantee to reprocess cannot be provided in advance; rather, each case is handled separately. In light of President Reagan's recent comments on the reprocessing of nuclear fuel, however, discussions with Sweden in particular may be slightly easier than before.

The entire renegotiation process is presently under review within the Reagan Administration although not much effort is being expended currently in that direction. The focus has been on implementation of the Congressional directive to renegotiate. It is still possibie that the renegotiation program will be modified or changed in time. However, the first order of business will be the implementation of the recent policy statement.

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ESSAY

On July 16 President Reagan issued a press statement and an accompanying fact sheet on nuclear proliferation. Prior to this issuance, the bilateral negotiators had no new Reagan policy to implement. This major announcement gave basic guidelines reinforcing the "longstanding objectives" of the US in nonproliferation areas. Emphasis was made on dealing with the security aspects of proliferation including working with other nations on "combatting the risks of proliferation." The tying together of proliferation policy with foreign policy adds a new aspect to the US doctrine.

The statement strongly defended continuation and strengthening of both the NPT and the IAEA. Safeguards issues were staunchly supported along with a continuation of efforts towards preventing the "spread of nuclear explosives to additional countries" and inhibiting the "transfer of sensitive nuclear material, equipment and technology."

The US policy on reprocessing was presented in a light that may be received enthusiastically by US nuclear trading partners. President Reagan declared that "the Administration will not inhibit or set back civil reprocessing and breeder reactor development abroad in nations with advanced nuclear power programs where it does not constitute a proliferation risk." An initial step towards regaining outside confidence in the US as a "reliable partner for peaceful nuclear cooperation under adequate safeguards" was taken with Reagan's directive to Executive Branch agencies to expedite export requests where the mandatory statutory requirements have been met.

Overall, the policy set forth seemed to be cognizant of the realities of nuclear power on the international scene. Reprocessing was accepted as a way to dispose of spent fuel rather than as a major proliferation risk, as was the case during the Carter Administration. The foundation of the Carter nonproliferation policy was the link between the spread of civilian nuclear power and the spread of weapons potential. Plans for reprocessing and a breeder reactor program were stopped or curtailed in the US under the assumption that the development of nuclear power programs not only in the US, but internationally, would lead to a "plutonium economy" wherein the availability of nuclear weapons substances would increase and detection of the movement of plutonium into weapons programs would become more difficult.

However, US efforts to stop the spread of reprocessing development were met with hostility and suspicion. Other governments saw the move as a threat to their civilian power programs. In many countries, notably within the ranks of some long-time allies, the result was a drop in confidence in the US commitment to the NPT as well as lowered confidence in continued access to nuclear material and technology. The US had imposed additional safeguards restrictions without any commensurate assurance of supply. In formulating this policy, it was believed that dependence on US technology would force other countries to accept US policy.

In hindsight, the premises of the Carter policy on nonproliferation are questionable. US nuclear technology is no longer necessarily the most advanced in the world. It has been argued that the NNPA eroded the US position in nuclear technology and overseas sales. Politically there has been much international criticism of the NNPA, and confidence in the US as a reliable uranium, enrichment and technological source has weakened. It has become clear that the unilateral approach to nuclear trade decisions did not facilitate international acceptance of nuclear export policies. The Reagan Administration has now indicated a willingness to be less restrictive towards countries where the risk of weapons-use is not viewed as significant.

President Reagan has stressed that his stand on nonproliferation is just as serious as any past commitment has been. His shift in policy emphasis reflects a review of the successes and failures of the past approach and a rethinking of US action. It is now apparent that the US must work within an international forum towards nonproliferation ends if those ends are to be achieved. In the US, the NNPA will possibly be revised to conform with a more realistic view of the international nuclear situation.

Other countries have remarked favorably on the attitude put forth in the Reagan statement on nuclear proliferation. However, the document fails to address some specific questions. The implementation of the policy will be the point on which it is judged. The various approaches to nuclear nonproliferation will continue to be considered in the implementation of US policy and in the plotting of the US course of nuclear participation.

Australia

The Australian government's stand on nonprolifer-

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ation has been a strong one emphasizing prior consent rights over the use and transfer of Australian origin uranium. Last November, the Australian Minister for Foreign Affairs announced that the government had decided to permit reprocessing of Australian origin uranium under certain conditions. The conditions outlined by the Minister included approval of reprocessing in association with power production, storage and use of plutonium in a manner minimizing nuclear proliferation risks, agreement by the end user of continued consultation and review of the reprocessing conditions, and end user commitment to support development of more effective international control measures.

In Australia, bilateral safeguards agreements are in force with the US, Canada, the United Kingdom, Sweden, Finland, the Philippines and Korea. Administrative Arrangements (AA) covering implementation of the agreements, are required under the bilateral agreement structure. Some AA's, including one with the US, are not in place. However, negotiations on the AA's are progressing at a rate so as not to impede the administration of the bilateral agreements already "in place."

Safeguards agreements negotiated but not yet in force exist with France (contingent upon Euratom/IAEA/French trilateral agreement) and Euratom (subject to finalization of AA and individual member states approval). The ratification of the French/European Economic Community (EEC)/IAEA trilateral agreement has been delayed due to the change in the French government.

Negotiations of a safeguards agreement with Japan are proceeding slowly as Japan is unwilling to settle prior to the completion of the Euratom agreement. Japanese negotiators appear to be delaying because they do not wish to settle on any matter of substance without first being convinced that they will not be disadvantaged vis-a-vis Euratom members. The most recent safeguards negotiations between Australian and Japanese officials made substantial progress but failed to resolve various issues.

An Australian safeguards agreement with Switzerland is planned but has not yet been negotiated. Negotiations are also possible in the future with three EEC members; West Germany, Italy and Belgium. The recent trade discussions between Australia and Egypt at ministerial levels may indicate that safeguards negotiations between the countries are possible.

Canada

The strictest Canadian bilaterial agreements, Category I, require the party to be an NPT signator or to have made an equivalent commitment to nonproliferation. Canada has Category I agreements with Finland, Sweden, the EEC, the US, Japan, Korea, the Philippines, Australia and Romania. Under these agreements, Canada can export uranium and nuclear technology and equipment. Bilateral agreements with Spain and Argentina have been negotiated, but cannot be signed until the two countries comply with the safeguards requirements. Arrangements for trade under existing contracts are continuing but no new nuclear-related contracts will be signed until the bilateral agreements are in force.

Canada has completed a negotiated agreement with Switzerland, but it has not yet been signed. The agreement is acceptable to the Canadian government. However, the Swiss federal government does not believe it can impose "strings" on the nuclear programs of the cantons, as would be the case if the agreement were in force.

Negotiations for bilateral agreements with Mexico, Indonesia and Yugoslavia are in early stages. Further along is the agreement between Canada and Euratom. Negotiations began in January 1978 and good progress is reported. It is very possible that the agreement will be completed this year.

As is the case with the US, it is believed by some that Canada's strict safeguards policy has been a hindrance to the country's position in international commercial competition. There is currently an internal review of Canada's nuclear industry by the Energy Mines and Resources Department. However, Canadian policy on safeguards and nonproliferation has been confirmed by the government, and the Energy Minister recently stated that the government does not intend to moderate the safeguards stance despite a reduction of nuclear sales.

Canada's policy on reprocessing has never been one of outright denial. Rather, the policy calls for a "mutual agreement right" over reprocessing. There are guidelines for the implementation of this right with Canada's nuclear partners and this allows more flexibility than similar US agreements. The Canadians may be headed down the same road as the Australians in their agreements with a move away from case-by-case consideration of reprocessing. The alternative is an agreement based on a nuclear program which has been set forth and agreed to in advance by both sides.

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RAW MATERIALS

SPANISH NUCLEAR PROGRAM — PART I

Introduction

The Spanish government initiated a multi-phase nuclear power program in the early 1960's. The program was designed to do industry-related research and development, to participate in the construction of nuclear power plants, and to supply nuclear fuel to the utilities. The program was later expanded to include involvement in uranium exploration, exploitation, and enrichment outside of Spain.

Spain's nuclear program is controlled by the Ministry of Industry and Energy. The functionary agencies include the state owned Junta de Energia Nuclear (JEN) which was formed in the 1950's for the purpose of prospecting and exploring for uranium inside Spain, and Empresa Nacional del Uranio S.A. (ENUSA) which is controlled 60 percent by the state-owned holding company Institute Nacional de Industria (INI) and 40 percent by seven private utilities. ENUSA was created to develop a total fuel cycle for Spain. The company's responsibilities include uranium exploration, all mining and milling, conversion, enrichment, fuel fabrication and spent fuel treatment in Spain. In addition, ENUSA actively participates in uranium ventures and/or procurement outside of Spain. ENUSA procures the fuel for all Spanish reactors in operation, under construction, and in the planning stage.

The production of nuclear power in Spain began in the late 1960's. By late 1972, three nuclear power plants were operating at a combined capacity of 1100 MWe. Construction of seven additional plants with a capacity of 6555 MWe was well underway by 1976. The first of the seven plants, Almaraz I, with a capacity of 930 MWe, began producing electricity in late June, 1981. The second plant, Asco I, is scheduled for startup in late 1982. The remaining five plants, plus two larger plants having a combined capacity of 2005 MWe but not yet under construction, are scheduled to be operational by the 1986-88 period. The nuclear generating capacity for Spain will total 9660 MWe at that time if the present construction schedule is maintained. Figure 1 shows the location and status of nuclear power plants throughout Spain.

Fuel Supply Schedule

ENUSA has acquired fuel for the present Spanish requirements based on a schedule of about 12,000 tonnes U_3O_8 cumulative through 1987. Domestic supply capability has been about 200 tonnes U_3O_8 annually. ENUSA has entered into long-term purchase agreements to receive the remainder of its requirements from Canada, Niger, South Africa and Namibia. Enrichment services have been, and will continue to be, supplied in part by France, England, Russia and the US.

Spain's 1980 production of 200 tonnes U_3O_8 was obtained from two different mine and mill operations. About 130 tonnes per year were produced from the Mina FE mine at Ciudad Rodrigo in the province of Salamanca. The remaining 70 tonnes U_3O_8 were produced from the Mina El Pedregal at Don Benito, Badajoz Province. The production facility at Ciudad Rodrigo is scheduled for expansion to 600 tonnes U_3O_8 annually by 1985-86. In addition, ENUSA plans to produce another 100 tonnes U_3O_8 annually as a by-product to phosphate production by 1984-85. ENUSA estimates that domestic production of U_3O_8 will total at least 800 tonnes per year by the 1985-86 period and will make a substantial contribution to the then annual requirements estimated to be 2500 tonnes U_3O_8.

ENUSA has taken added precaution to insure long term uranium supplies for Spain through participation in several foreign uranium projects. ENUSA has a ten percent stake in the Compagnie Miniere d'Akouta (COMINAK) in Niger which began producing uranium concentrates in 1978. ENUSA also acquired a 12.5 percent participating interest in the Conwest Canadian Uranium Exploration Joint Venture in Saskatchewan and Quebec in 1975. The company has a 25 percent interest in an exploration joint venture in the Karoo district in South Africa and has a 49 percent interest in a joint venture with the Colombian Institute de Asuntos Nucleares (IAN) which conducts exploration activities in Colombia. In addition, ENUSA holds an 11.1 percent interest in Eurodif, a joint venture for uranium enrichment located in France. ENUSA supplies U_3O_8 to Eurodif for enrichment services.

Uranium Resources

Exploration for uranium resources in Spain began about 1950. JEN began regional reconnaissance operations in the continental sediments of the interior regions, and in the igneous and metamorphic rocks of the mountainous areas. Approximately 40 prospective radiometric anomalies and mineral occurrences were located and JEN selected the most favorable for further

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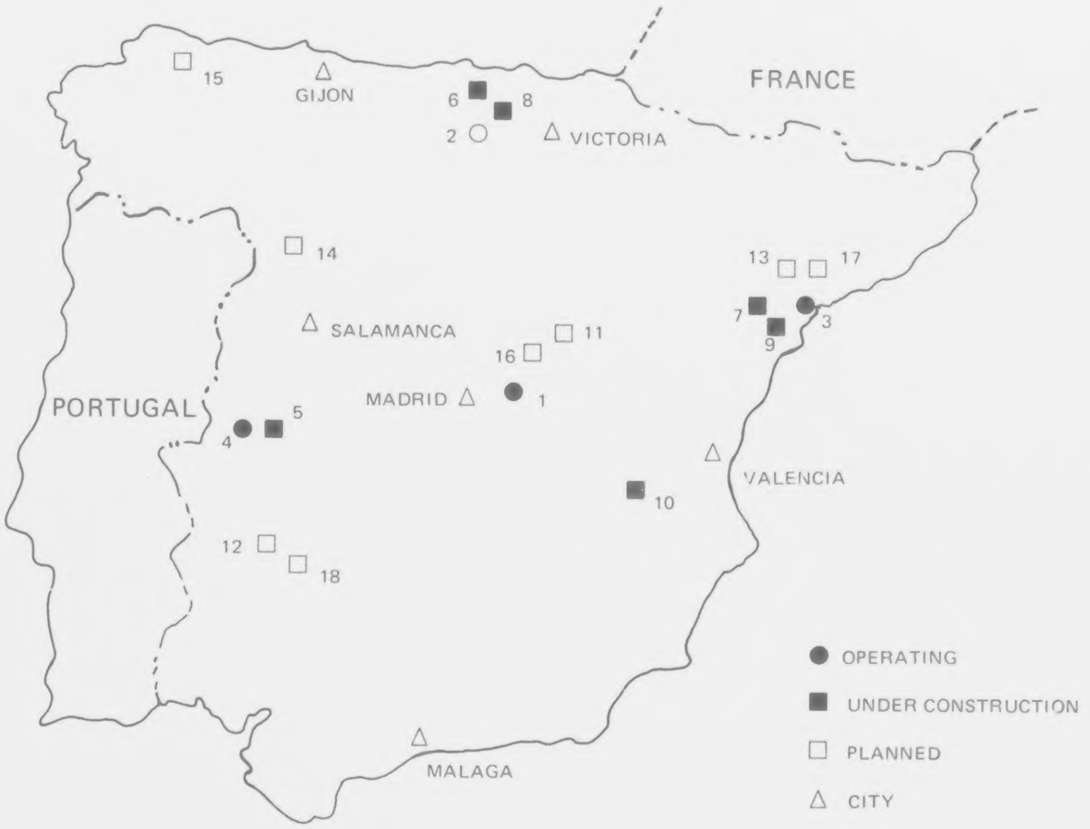
RAW MATERIALS


15
GIJON
6
8
2
VICTORIA
FRANCE
14
13
17
7
3
9
SALAMANCA
11
16
PORTUGAL
MADRID
1
5
4
VALENCIA
10
12
18
MALAGA
● OPERATING
■ UNDER CONSTRUCTION
□ PLANNED
△ CITY

PLANT STATUS

OPERATING
1. ZORITA 160 MWe
2. GARONA 460 MWe
3. VANDELLOS I 480 MWe
4. ALMARAZ I 930 MWe

UNDER CONSTRUCTION
5. ALMARAZ II 930 MWe
6. LEMONIZ I 930 MWe
7. ASCO I 930 MWe
8. LEMONIZ II 930 MWe
9. ASCO II 330 MWe
10. CONFRENTES 975 MWe

PLANNED 1986 to 1995 PERIOD
11. TRILLO I 1030 MWe
12. VALDECABALLEROS I 930 MWe
13. VANDELLOS II 930 MWe
14. SAYAGO 1070 MWe
15. REGODOLA 1100 MWe
16. TRILLO II 1000 MWe
17. VANDELLOS III 1000 MWe
18. VALDECABALLEROS II 975 MWe

Figure 1

LOCATION AND STATUS OF
NUCLEAR POWER PLANTS IN SPAIN

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appraisal. Important uranium mineralization was subsequently discovered in at least three separate districts. JEN continued exploration and, in addition, developed the technology for treatment of the uranium ores.

The properties were transferred to ENUSA for exploitation in 1973 at which time evaluated reserves (designated by JEN) were estimated at 5000 tonnes U_3O_8 at an ore grade of 0.10 percent. The exploration activities are ongoing and ENUSA has recently estimated evaluated reserves for the three deposits as listed in Table 4.

Table 4

URANIUM RESERVES OF SPAIN

Mine	Province	Tonnes U_3O_8
Mazarete	Guadalajara	2,000
Mina El Pedregal	Badajoz	800
Mina FE	Salamanca	15,500
Total evaluated Reserves*		18,300

*Equivalent to reasonably assured resources recoverable at a forward cost of $35.00 lb U_3O_8.

The uranium reserves of Mina FE and other mines at Ciudad Rodrigo represent about 82 percent of total Spanish evaluated reserves. This district has been the focus of most exploration completed to date. ENUSA plans to increase exploration and mine development in the area to meet the proposed production schedule. Exploration in other potential areas may be increased also. As of July 1, JEN assigned all prospecting and exploration duties to ENUSA, including an assignment to explore about 100,000 square kilometers of sedimentary rocks in central Spain. The task to explore the sediments was originally assigned to Plan Nacional de Exploracion de Uranio (PNEU) in 1974. Work on the project may be intensified under ENUSA.

Several foreign groups are in direct competition with ENUSA for exploration areas. The US companies Exxon Corp. and Chevron Exploration Corp. and England's British Petroleum Ltd. have been active in Spain for several years. If they are successful in their exploration efforts, the resulting uranium would first be offered to ENUSA for purchase at the world market price at time of production. The status of each foreign program is uncertain at this time. However, it is reported that each company has experienced only moderate success.

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STATISTICAL DATA

EXCHANGE VALUE $23.50/lb. U_3O_8
Determined as of July 31, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:
A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:
A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of July 31, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
24.40	2.9	10	5

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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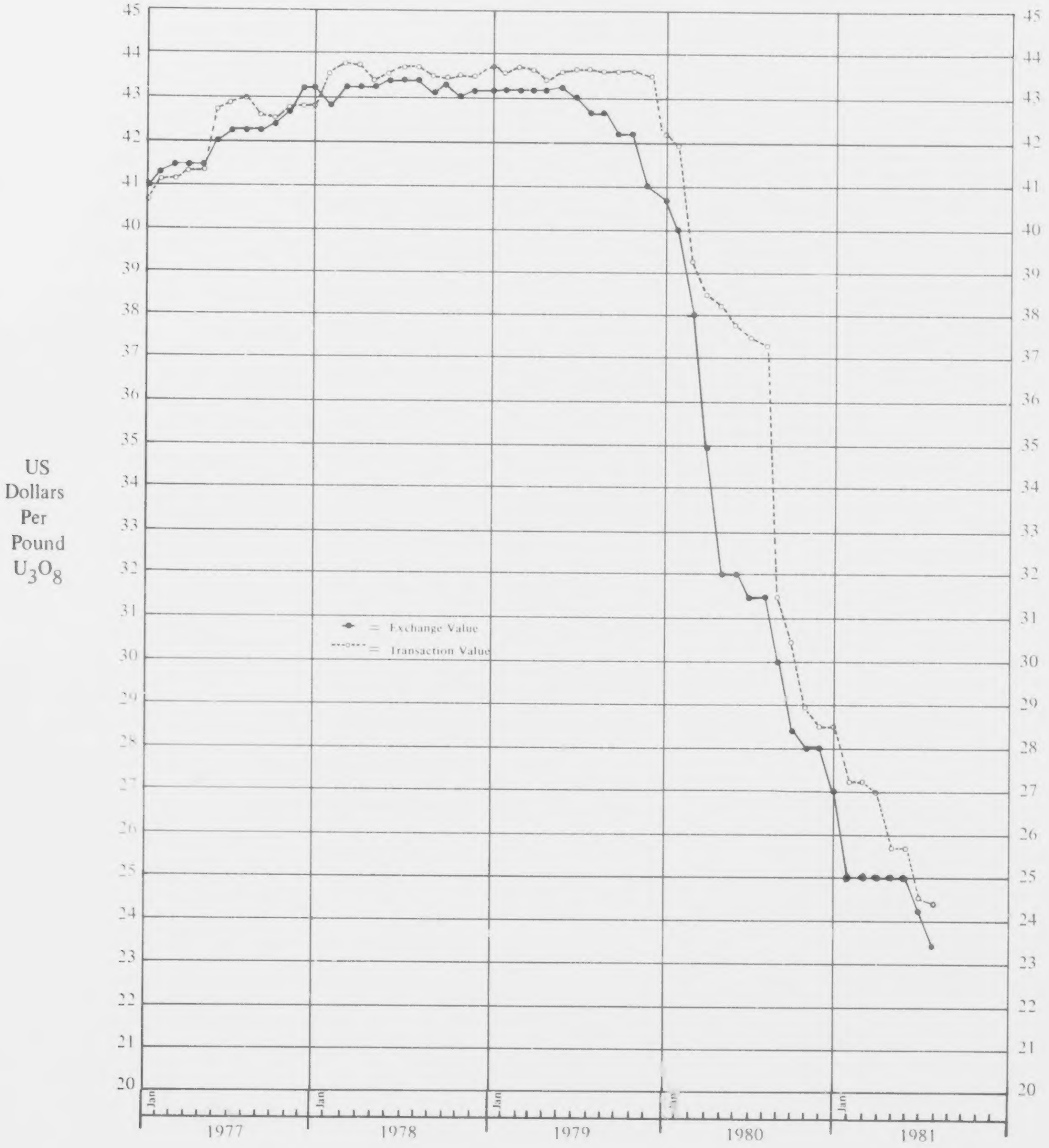
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50					

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40					

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	23.50	51.81	61.09
France (franc)	136.87	301.74	355.82
FRG (mark)	57.71	127.23	150.04
Japan (yen)	5,614	12,377	14,595
Switzerland (franc)	50.09	110.42	130.21
UK (pound)	12.64	27.87	32.86
Australia (dollar)	20.67	45.56	53.73
Canada (dollar)	28.76	63.41	74.77
Niger, Gabon (CFA)	6,843	15,087	17,791
South Africa (rand)	22.15	48.83	57.58
Sweden (kröner)	122.52	270.12	318.53

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

CONVERSION VALUE $1.15/lb. U as UF$_6$
Determined as of July 31, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and/or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

LOAN USE CHARGE RATE 5-1/2%
Determined as of July 31, 1981

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed as a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1583	1981	101–300	–	US	Far East	See text
1584	1981	301–600	–	US	Far East	See text
1586	1981	101–300	99	US	US	

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as percent of Current C.V.	Seller Group	Buyer Group	Remarks
Conversion Transactions						
1567	1983–85	1,001–2,000	104	US	US	
1585	1981	301–600	90	US	non–US	

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*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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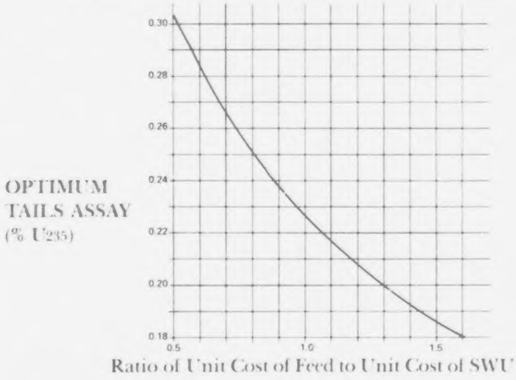
OPTIMUM TAILS ASSAY

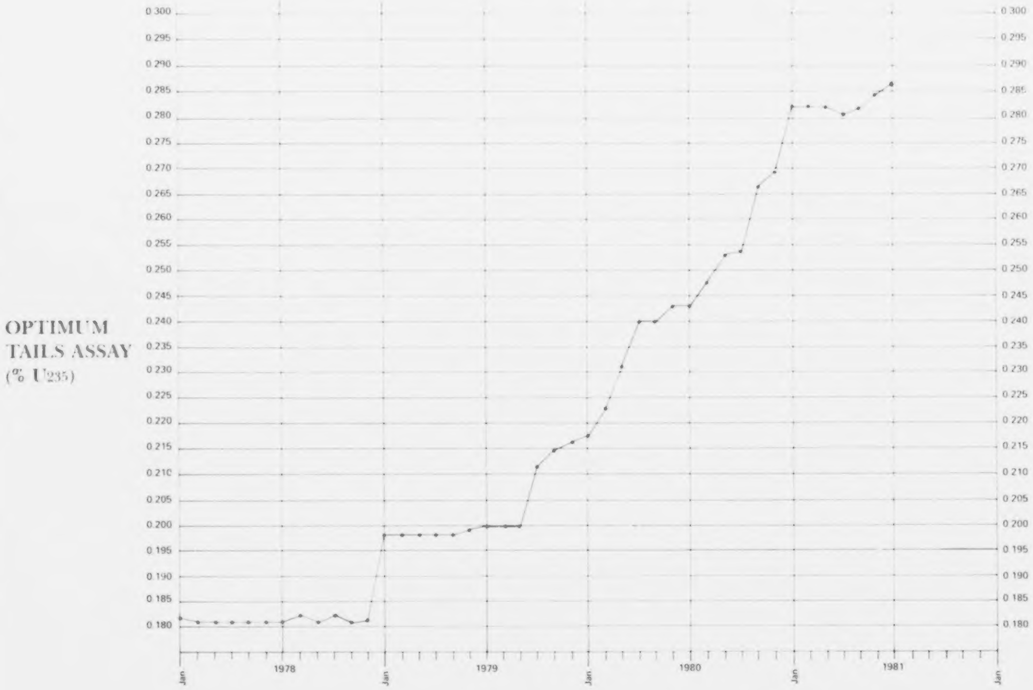
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
Ann. Avg. 1970(5)(7)	110.0	116.3	91.36	3.88	3.87	3.69	3.28
Ann. Avg. 1971(5)(7)	114.1	121.3	96.02	4.12	4.15	3.97	3.49
Ann. Avg. 1972(5)(7)	117.9	125.3	100.00	4.56	4.59	4.26	3.71
Ann. Avg. 1973(5)(7)	125.9	133.1	105.80	4.84	4.98	4.51	3.91
Ann. Avg. 1974(5)(7)	153.8	147.7	116.02	5.44	5.63	4.88	4.21
Ann. Avg. 1975(5)(7)	171.5	161.2	127.15	6.13	6.24	5.39	4.64
Ann. Avg. 1976(5)(7)	182.4	170.5	133.71	6.76	6.87	5.91	4.96
Ann. Avg. 1977(5)(6)(7)	195.1	181.5	141.70	7.28	7.67	6.43	5.39
Ann. Avg. 1978(5)(6)(7)	209.4	195.4	152.05	8.23	8.56	7.02	5.82
Ann. Avg. 1979 (6)(7)	236.5	217.4	165.46	9.27	9.49	7.60	6.32
Ann. Avg. 1980	274.5	246.8	177.36	10.26	10.61	8.29	6.96
Mar 1980	268.6	239.8	174.48	9.90	10.22	8.05	6.78
Apr 1980	271.3	242.5	–	10.00	10.30	8.12	6.79
May 1980	271.9	244.9	–	10.18	10.37	8.17	6.78
Jun 1980	273.5	247.6	178.93	10.13	10.69	8.24	6.87
Jul 1980	276.2	247.8	–	10.24	10.82	8.35	6.96
Aug 1980	278.2	249.4	–	10.38	10.78	8.39	7.02
Sep 1980	278.8	251.7	182.92	10.54	10.94	8.46	7.14
Oct 1980	282.2	253.9	–	10.58	11.00	8.52	7.20
Nov 1980	283.4	256.2	–	10.73	11.06	8.59	7.29
Dec 1980	286.6	258.4	183.98	10.86	11.31	8.68	7.39
Jan 1981	291.5R	260.5	–	10.91R	11.31R	8.74R	7.41R
Feb 1981	295.7R	263.2	–	11.15R	11.36R	8.80R	7.43R
Mar 1981	298.9	265.1	188.14R	11.13R	11.50R	8.84	7.47R
Apr 1981	302.8	266.8	–	11.30	11.63	8.94	7.51
May 1981	304.1	269.0	–	11.25P	11.71P	8.95P	7.55P
Jun 1981	304.7P	271.3P	190.91P	–	–	9.05P	7.56P

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Monthly data 1970-1978 for Price Indexes and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Monthly data 1977-1979 for Employment and Earnings SIC codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.

(7) Monthly data 1970-1979 for Employment and Earnings SIC code 36 appear on page 23 of Nuexco Report 154.

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AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	198.5	190.04
Annual Avg. 1979	248.8	196.34
Annual Avg. 1980	321.8R	217.88R
Mar 1980	340.3	214.83
Apr 1980	328.4R	215.14R
May 1980	335.6R	214.81
Jun 1980	338.8R	214.14
Jul 1980	347.8R	221.44
Aug 1980	352.0R	219.95
Sep 1980	350.3R	219.45
Oct 1980	348.2R	220.93R
Nov 1980	350.4R	221.31R
Dec 1980	351.7R	221.63R
Jan 1981	357.8R	228.51R
Feb 1981	356.6R	228.33R
Mar 1981	355.2R	227.56R
Apr 1981	354.6	227.26
May 1981	353.3P	235.12P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6111.0), Table 3.

(2) Australian Bureau of Statistics, Canberra: "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 1.7 and 1.8 of Nuexco Report 138.

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CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Annual Avg. 1980	247.2R	10.59	8.05	8.50
Mar 1980	239.5	10.34	7.83	8.26
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.4	10.58	8.14	8.65
Sep 1980	252.0	10.85	8.24	8.71
Oct 1980	256.0	11.05	8.28	8.82
Nov 1980	257.7	11.11	8.38	8.77
Dec 1980	258.4	11.13	8.32	8.92
Jan 1981	263.3R	11.27	8.51	8.90
Feb 1981	263.6R	11.43	8.59	9.00
Mar 1981	265.4R	11.47P	8.63P	9.17P
Apr 1981	267.7	11.72P	8.76P	9.34P
May 1981	269.6P	—	—	—
Jun 1981	271.9P	—	—	—

P = Preliminary R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)
Annual Avg. 1970(3)	7.34	100.3(4)	
Annual Avg. 1971(3)	7.88	106.4(4)	59.1
Annual Avg. 1972(3)	8.79	113.3(4)	63.9
Annual Avg. 1973(3)	10.51	124.1(4)	72.3
Annual Avg. 1974(3)	13.18	138.5(4)	85.3
Annual Avg. 1975(3)	16.71	157.2(4)	100.0
Annual Avg. 1976(3)	19.30	174.7(4)	115.1
Annual Avg. 1977(3)	23.87	194.4(4)	130.0
Annual Avg. 1978(3)	27.14	137.2	142.7
Annual Avg. 1979(3)	30.18	155.3	164.5
Annual Avg. 1980	35.53	176.7	192.1
Mar 1980	33.65	168.0	181.7
Apr 1980	–	170.0	184.2
May 1980	–	171.9	187.0
Jun 1980	34.48	174.6	189.0
Jul 1980	–	177.2	192.7
Aug 1980	–	179.2	196.8
Sep 1980	36.19	182.8	199.8
Oct 1980	–	186.3	203.1
Nov 1980	–	187.8	205.6
Dec 1980	37.69	189.9	206.5
Jan 1981	–	191.0	207.2
Feb 1981	–	193.8	209.8
Mar 1981	39.26	195.2	209.9
Apr 1981	–	196.4	211.6
May 1981	–	197.7	213.2
Jun	–	200.0	–

---

(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."
(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 19 of Nuexco Report 140.
(4) April 1970 = 100.00.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1393			350	
1475	1000			UF_6
1480	200	300	300	
1490	1000			UF_6
1540	300	750		UF_6
1550	600			
1552	200			
1562			150	Long term
1575			500	Long term
1581	100	150	150	Long term
1595	600	600	800	
1600			200	Long term
1610		100		
1637	500	500		
1678		275		
1685	100			
1698	100			
1707	100			
1719	30			
1727	500			
1730	30			
TOTAL	5360	2675	2450	
Available for Loan:				
1429	300			UF_6
1602	400			
1646	275	275	275	
1695	225	325	325	UF_6
TOTAL	1200	600	600	

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
Inquiries to Purchase:				
1459			200	Long term
1462			100	Long term
1603		100	100	Long term
1634	400	400		
1650	200			
1704		200	200	Long term
1724	500	500	500	Long term
1731	250			
1732	50			
TOTAL	1400	1200	1100	
Inquiries to Borrow:				
1621	300			
1699	250	650		
TOTAL	550	650		

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*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1451	75			
1475	700			
1607	1000			
1609	500	1500	1000	Long term
1619		200	100	
1661		400	400	Long term
TOTAL	2275	2100	1500	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1594		400	950	Long term
1622		400	400	Long term
1626	75			
1688	500			
1689		300	300	Long term
1722	450			
TOTAL	1025	1100	1650	

*Measured from the date of this Report.

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 156

Downward pressure on the market continued this month as evident by the **Exchange Value** decline to \$23.50 per pound U_3O_8 from \$24.25 per pound U_3O_8 the previous month. Seller competition for the limited buyer interest has been apparent and substantial quantities of material are being offered at about the level of this month's Exchange Value.

Holders of inventory now represent two-thirds of the sellers with available near-term material, an increase over the previous month. Active inquiries to sell in the spot and near-term market remained fairly stable and amount to about 5.4 million pounds U_3O_8. Uranium in the form of UF_6 continues to make up a large percentage of the available material, thus creating demand for swaps and deconversions in order to respond to requests for U_3O_8. Total of inquiries to purchase in the spot and near-term market increased slightly to 1.4 million pounds.

Three uranium transactions are reported this month. The total of material involved is approximately one million pounds. The **Transaction Value** decreased slightly to \$24.40 per pound U_3O_8. Ten transactions qualified in this month's calculation. As buyers and sellers alike investigate marketing strategies given the current market decline and high cost of money, interest continues in the loan market. The **Loan Use Charge Rate** remained at the previous month's level of 5½ percent.

The **Conversion Value** held constant for the third straight month at \$1.15 per pound U. Two secondary market transactions for conversion services closed this month involving approximately two million pounds U of conversion services. The Conversion Value reflects individual utility requirements and financial considerations when considering entering the near-term secondary market for conversion services. Advantages of the deconversion swap are covered in this Report.

President Reagan recently issued a policy statement on nuclear proliferation which is intended to give direction to the US nuclear power program and also to those involved in negotiating US nuclear bilateral agreements. A look at nuclear policy and an update on safeguards agreements of the US, Australia and Canada are covered in this month's *Essay*.

This month's *Topical Essay* continues the discussion on unconventional transactions with a look at the option as a strategic tool.

An in-depth look at Spain's nuclear program including uranium reserves is begun in this month's *Raw Materials* essay.

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SEPTEMBER 1981 NUMBER 157

Monthly Report on the Uranium Market

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MONTHLY REPORT ON THE URANIUM MARKET

September 1981 No. 157

JAMES E. VAUGHAN, *EDITOR* TERESA L. ELMS, *ASSOCIATE EDITOR*

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FORWARD

We are pleased to announce that Mrs. France Millet Hamilton has joined Nuexco as representative for Nuexcoeurope-Atlantic. She will represent Nuexco in the United Kingdom, France, Spain and Portugal. She was educated in the United Kingdom and graduated in Economics from St. Andrews and Cambridge Universities. Since 1967 France has held various posts in the nuclear industry. In London she was associated with the United Kingdom Atomic Energy Authority and Rio Tinto-Zinc Corp. Ltd. She also spent several years in Paris with Framatome. Her experience has covered uranium marketing, procurement and sales contracts.

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URANIUM MARKET

AUSTRALIA

Movement towards mine and mill completion is continuing at Energy Resources of Australia's (ERA) Ranger complex. Full-scale production is scheduled to begin in October 1981 and regular concentrate shipments will likely commence in November or December. A settlement with the Seamen's and the Waterside Workers' Unions is needed within the next few months to insure unhindered shipments. Currently the two unions are refusing to handle uranium-carrying vessels at the ports of Darwin, Brisbane and Sydney.

Denison Mines of Canada Ltd. must conclude satisfactory agreements with the Northern Land Council (NLC) and local aboriginal land owners before its Koongarra project can achieve development status. The NLC terminated negotiations with Denison three months ago and has concentrated its attention on Pancontinental Mining Ltd.'s Jabiluka project. There are no indications of when discussions with Denison will be resumed.

CANADA

Under the 1961 Mineral Disposition Regulations of the province of Saskatchewan, all uranium or other minerals extracted from uranium ore obtained from Saskatchewan Crown lands are subject to that province's royalty system. The method of calculation and payment of royalties in respect to this uranium was set forth by the province's Department of Mineral Resources in 1977. Since Saskatchewan mining operations are approaching production start-up, a look at the method of calculating the royalty owed may be of interest.

The Saskatchewan royalty system applies to a single mine complex and has two components, a basic royalty and a graduated royalty. The basic royalty is fairly straightforward and requires payment of three percent of the gross value of sales for a given year. The graduated royalty is more complex and is calculated as a percentage based on a profitability ratio (operating profit to capital investment). Determination of the operating profit and capital investment components will be discussed later.

The following royalty table determines the amount of graduated royalty due:

Table 1

DETERMINATION OF SASKATCHEWAN GRADUATED ROYALTY

Profitability Ratio (Operating Profit to Capital Investment)	**Graduated Royalty Payable**
Below 15 percent	None
On that portion above 15 percent but below 25 percent	15 percent of operating profit in this bracket
On that portion above 25 percent but below 45 percent	Amount in previous bracket plus 30 percent of operating profit in this bracket
On that portion above 45 percent	Amount in previous brackets plus 50 percent of operating profit in this bracket

The capital investment figure is computed by summing expenditures for exploration, development and construction on the mine mill complex for each year. The total amount of investment is multiplied by an interest rate factor (that year's average prime interest rate plus ten percent of the prime rate). This interest rate factor is applied to the summed capital expenditures for the previous year(s) as well. This procedure is repeated each year until commercial operation begins.

The accumulative annual capital investments then become the denominator in the profitability ratio. This figure is fixed at the time of commercial production and cannot be changed unless there is a significant addition to the production capacity of the mine mill complex.

The capital investment is then divided by operating profit to come up with the profitability ratio. Operating profit is determined by taking gross sales and subtracting the sum of expenses: production costs, administrative and corporate expense allowance, marketing expense allowance, working capital allowance, the basic royalty, and the capital recovery allowance. Each of these is defined in detail:

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Production costs represent all expenses related to operating the production unit after commercial operation begins. These include an allowance for social capital costs and operating losses related to social capital items. Social capital covers investments made for providing services to a community or living quarters which are necessary for the operation of the production unit.

Not included in the production costs are expenses for depletion or exhaustion of a mine, depreciation, interest and expense on funded debt, expenses incurred for exploration, specific income taxes and administrative and corporate expenditures. Also payment or royalty expenses towards purchasing an option for or acquiring mineral rights are not included in calculating production costs.

The administrative and corporate expense allowance is an amount equal to five percent of the production costs. The marketing expense allowance is equal to three-fourths of one percent of the gross sales. The working capital allowance is an amount equal to the interest rate factor (the prime interest rate plus ten percent) times 10 percent of the production costs.

The capital recovery allowance is equal to the unrecovered capital investment plus that amount multiplied by the interest rate factor. As mentioned earlier, the capital investment figure becomes fixed at the time of the project's commercial operation. This figure becomes the initial balance in the capital recovery "bank". Each year the maximum amount of operating profit is applied to the capital recovery bank. The balance after profit deduction is multiplied by the interest rate factor and is carried forward to the following year. This method allows the royalty payer to make back the capital investment plus a percentage before graduated royalty payments begin.

As mentioned above, the exploration costs incurred once commercial operation begins are not included in the calculation of production expenses. However, once the owner of the mine/mill complex has depleted the capital recovery bank and begins to pay the graduated royalty tax, a tax credit based on a percentage of these exploration costs is given.

Table 2 is an example of a royalty calculation for a first year of operation based on the following data:

1. $17,600,000 in the capital recovery bank.
2. Production unit sells 300,000 pounds U_3O_8 at $15/pound U_3O_8, produced at $5/pound U_3O_8.

Table 2

EXAMPLE OF GRADUATED ROYALTY CALCULATION FOR AN EARLY YEAR OF PRODUCTION

	Thousands of Dollars
Revenues	1,500
Less Production Costs	(2,320)
Less Other Expenses	(200)
Less Basic Royalty	(135)
	1,845
Remaining Capital Balance	17,600
Less	(1,845)
Operating Profit	0
Remaining Bank	$15,755

In this example no graduated royalties are paid in the first year of production. The capital recovery bank balance of $15,755,000 is multiplied by the interest rate allowance. The new figure is carried forward and becomes the remaining capital balance number for the following year's calculation.

Table 3

EXAMPLE OF GRADUATED ROYALTY CALCULATION FOR A LATER YEAR OF PRODUCTION

	Thousands of Dollars
Revenues	30,000
Less Production Costs	(10,200)
Less Other Expenses	(1,000)
Less Basic Royalty	(900)
	17,790
Remaining Capital Balance	10,000
Less	(17,790)
Operating Profit	7,790
Remaining Bank	0

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Table 4

Percent Ratio of Operating Profit to to Capital Investment	Size of Increment (%)	Royalty Rate (%)	Incremental Operating Profit (Thousands of $)	Incremental Royalty (Thousands of $)
Below 15%	15	0	2,640	0
On that portion above 15% but below 45%	10	15	1,760	264
On that portion above 25% but below 45%	20	30	3,520	1,056
On that portion above 45%	1.6	50	282	141
	46.6		8,202	1,461

A calculation of the graduated royalty possible in a later year of production is shown in Table 3. In this example, the production unit has depleted its Capital Balance and has operating profits which are subject to the graduated royalty tax. The calculation is based upon:

1. $10,000,000 in the capital recovery bank.
2. Production unit sells two million pounds U_3O_8 at $15/pound U_3O_8, produced at $5/pound U_3O_8.

Table 4 applies the graduated tax formula to the operating profit and capital investment figures in Table 3. The profitability ratio is 46.6 percent and the total graduated royalty due is $1,461,000.

FAR EAST

As noted in last month's Report, **Japan's** Ministry of International Trade and Industry (MITI) submitted a policy report which recommended consideration of uranium stockpiling in Japan. Based on a desire for security of supply, it would seem that such a stockpile would be in the form of enriched product.

Implementing such a plan brings up questions of financing: who would purchase and maintain such a stockpile? Although it is premature for a definite answer, a possible solution is already in place. A private company, Japan Nuclear Fuel Service, was organized in 1980 to own and operate a 1200 ton per year reprocessing plant which is scheduled to be built by 1990. Discussions concerning the financing for this project are ongoing with the Japan Development Bank and include the topic of financing a uranium stockpile. Any action, however, is likely to be slow in coming. Moreover, in view of the current "long" position of the Japanese utilities, it is possible that the stockpile would not be built by new purchases, but rather by transfers from the utilities. The utilities could accelerate conversion and enrichment deliveries and return the enriched product to Japan earlier than would have otherwise occurred.

Korea's current nuclear program includes nine units totaling some 7400 MWe which are scheduled for operation prior to 1990. Included in this total are six Westinghouse PWR's (one of which is currently in operation), two Framatome PWR's and one Candu unit (scheduled for operation in 1982). Uranium requirements will be approximately three million pounds annually by 1990.

Based on Korea's substantial inventories and existing supply arrangements with Australian, Canadian, French and US sources it appears that new supplies are not needed until the late 1980's. These factors, combined with a reputation for hard bargaining, suggest that Korea will be in no hurry to conclude new supply contracts and will shop carefully before buying.

Taiwan Power Company's (TPC) current nuclear program includes two units in operation, a third unit expected to be in operation within a month, and three additional units under construction with anticipated

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operating dates of 1982, 1984 and 1985. With nearly 5000 MWe of nuclear capacity expected to be on line in 1985, Taiwan's uranium needs will approach two million pounds annually by that date.

Units 7 and 8 have yet to be ordered and lively competition, based largely on comparative financing advantages, has developed between US and French interests. Whatever the outcome, the units would not operate before the late 1980's or early 1990's. If the French receive the reactor order, it is possible that fuel (uranium and enrichment) will be included, as was the case earlier this year in Korea.

Political constraints have limited Taiwan's geographic diversity in establishing its uranium supply arrangements and have motivated a policy of holding substantial inventory both in the form of U_3O_8 and fabricated fuel. As a consequence, additional supplies, even to maintain desired inventory levels, are not needed until after 1985. It is not surprising, therefore, that Taiwan's procurement efforts are being pursued in a deliberate manner with a special view towards price advantage.

UNITED STATES

Nuexco has revised its estimates of US Nuclear Generating Capacity and US Apparent Future Consumption. The estimates were last printed in Report 147, November 1980. Comparisons of November 1980 and current Nuexco estimates are presented in Tables 5 and 6. The greatest change occurred in the Reactors Under Construction category for 1981. Reactors in this

Table 5

COMPARISON OF NUEXCO ESTIMATES OF US NUCLEAR ELECTRIC GENERATING CAPACITY REPORT 147 (NOVEMBER 1980) vs. THIS REPORT (Thousands of MWe — Net)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
US Reactors Operational										
Report 147	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8
Report 157	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0
Difference	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
% Change	+10.3	+10.3	+10.3	+10.3	+10.3	+10.3	+10.3	+10.3	+10.3	+10.3
US Reactors Under Construction										
Report 147	3.2	8.2	14.7	21.5	28.2	34.6	41.1	47.1	54.3	60.8
Report 157	-0-	3.9	8.4	14.1	23.0	28.2	34.8	41.9	47.8	54.3
Difference	-3.2	-4.3	-6.3	-7.4	-5.2	-6.4	-6.3	-5.2	-6.5	-6.5
% Change	-100	-52.4	-42.9	-34.4	-18.4	-18.5	-15.3	-11.0	-12.0	-10.7
US Reactors On Order										
Report 147	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Report 157	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Difference	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Total										
Report 147	54.0	59.0	65.5	72.3	79.0	85.4	91.9	97.9	105.1	111.6
Report 157	56.0	59.9	64.4	70.1	79.0	84.2	90.8	97.9	105.8	110.3
Difference	2.0	0.9	-1.1	-2.2	0.0	-1.2	-1.1	0.0	0.7	-1.3
Cumulative Difference	2.0	2.9	1.8	-0.4	-0.4	-1.6	-2.7	-2.7	-2.0	-3.3
% Change	+3.7	+1.5	-1.7	-3.0	-0-	-1.4	-1.2	-0-	+0.7	-1.2

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Table 6

COMPARISON OF NUEXCO ESTIMATES OF US APPARENT FUTURE CONSUMPTION REPORT 147 (NOVEMBER 1980) vs. THIS REPORT

(Millions of Pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
US Reactors Operational										
Report 147	16.3	16.6	17.0	17.2	17.3	17.3	17.2	17.1	17.0	16.8
Report 157	17.9	17.8	18.4	18.6	18.8	18.9	18.8	18.7	18.6	18.4
Difference	1.6	1.2	1.4	1.4	1.5	1.6	1.6	1.6	1.6	1.6
% Change	+9.8	+7.2	+8.2	+8.1	+8.7	+9.3	+9.3	+9.4	+9.4	+9.5
US Reactors Under Construction										
Report 147	4.6	6.3	10.1	13.2	15.5	18.2	17.9	20.5	23.4	23.5
Report 157	2.7	3.6	9.8	11.0	12.6	17.2	15.4	18.9	15.3	22.0
Difference	-1.9	-2.7	-0.3	-2.2	-2.9	-1.0	-2.5	-1.6	-8.1	-1.5
% Change	-41.3	-42.9	-3.0	-16.7	-18.7	-5.5	-14.0	-7.8	-34.6	-6.4
US Reactors On Order										
Report 147	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Report 157	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Difference	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Total										
Report 147	20.9	22.9	27.1	30.4	32.8	35.5	35.1	37.6	40.4	40.3
Report 157	20.6	21.4	28.2	29.6	31.4	36.1	34.2	37.6	33.9	40.4
Difference	-0.3	-1.5	1.1	-0.8	-1.4	0.6	-0.9	0.0	-6.5	0.1
Cumulative Difference	-0.3	-1.8	-0.7	-1.5	-2.9	-2.3	-3.2	-3.2	-9.7	-9.6
% Change	-1.4	-6.6	+4.1	-2.6	-4.3	+1.7	-2.6	-0-	-16.1	+0.3

category moved to Operational status for 1981 faster than had been anticipated. The NRC has outdone past performance in low power and full power licensing of power plants. However licensing is not approaching the rapid pace of the 1970's.

Overall, the change in US Nuclear Generating Capacity is not significant. The situation in the near term is affected on the plus side but the outlook for the future remains grim. The revised estimates indicate that the short term will be better than anticipated, while the long term may be worse owing to continuing schedule slippages of Reactors Under Construction.

When compared to the previous US Apparent Future Consumption forecasts, the new estimate does not represent much change. The US situation can be viewed as an indicator of the non-US situation with greater changes occurring in the US. Nuexco estimates of the situation outside the US show even less change versus the estimates presented in Report 147.

The US Bureau of Labor Statistics (BLS) periodically adjusts its industry employment series to more recent benchmarks (comprehensive counts of employment) to correct for sampling variability and for changes in industrial activity.

With the release of data for June 1981, the BLS introduced revised establishment survey estimates of employment, hours, earnings, and labor turnover to reflect the benchmarks for March 1980. These revisions affect the employment series from March 1979 (the previous complete count) forward to the current month's estimate. Revised historical data for average

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hourly earnings will be presented in a supplement to the BLS publication "Employment and Earnings" to be issued in August. As soon as possible thereafter, these revised historical data will be reprinted in the Nuexco Report.

TRANSACTIONS

There are four uranium transactions reported this month. One involves less than 50,000 pounds U_3O_8 for immediate delivery. The seller is a US producer; the buyer is a Far East government. The negotiations of this transaction have been ongoing for several months and as a result, the price involved is not completely reflective of the current market. The second transaction is for between 300 thousand and 600 thousand pounds U_3O_8 from a Canadian producer to a US utility. Delivery is to take place in 1981.

The third transaction is the sale of between 100 thousand and 300 thousand pounds U_3O_8 from a US producer to a US utility, with delivery taking place late next year. The final transaction reported this month is a long term sale from a Canadian producer to a US utility for between three million and six million pounds U_3O_8 to be delivered between 1984 and 1994.

There are no secondary market conversion transactions reported this month.

PRICING

The **Exchange Value** remained at $23.50 per pound U_3O_8, unchanged from last month. The following factors were significant in determining the Exchange Value this month.

1. Three near term transactions involving a total well in excess of one million pounds U_3O_8 are in the final stages of negotiation at prices near current Exchange Value.

2. Many sellers are offering or appear willing to offer large amounts of material at prices about equal to Exchange Value.

3. For the first time in many months, near term supply and near term demand are close to the same order of magnitude. Material being actively offered for sale and delivery over the next year totaled 7.2 million pounds U_3O_8 equivalent. Active inquiries to purchase during the same time frame came to 4.0 million pounds U_3O_8.

Although supply still exceeds demand by a ratio of about two to one, in the recent past it has been more on the order of ten to one. Thus the market currently seems to be showing some strengthening in the demand sector. Also indicative of strengthening is the fact that utilities represent about 60 percent of the purchasers actively seeking material in the near term market. Producer inquiries make up the balance of buying interest. The fact that utilities are now actively seeking over two million pounds U_3O_8 is significant because it has been some time since utility demand for near term delivery has been so strong.

On the supply side, about 60 percent of material being offered for sale comes from inventory holders. This activity continues to be the major bearish influence on the market.

The **Transaction Value** decreased slightly to $24.30 per pound U_3O_8. This months's calculation included ten transactions. The **Loan Use Charge Rate** remained at 5½ percent.

The US Department of Energy (DOE) has issued its annual Survey of United States Uranium Marketing Activity[1]. The *actual* average contract price for US origin uranium delivered to US buyers for calendar year 1980 was $28.15 per pound U_3O_8. This is up from previous estimates of $26.00 reported as of July 1, 1980[2] and $25.40 reported as of January 1, 1980[3].

The estimated average price for US origin uranium reported in the current DOE Report for 1981 delivery is $30.70, and for 1982 delivery is $37.70. These figures include market price settlements of market price contracts to the extent that settlements have been made. Average floor prices for market price contracts for US origin material were $46.45 for 1981 delivery and $49.70 for 1982. For the first time, DOE also included prices of non-US origin uranium delivered to US buyers. The average was $43.10 for 1980 delivery and $40.00 for 1981.

These figures would indicate that material is currently being delivered under old contracts at prices substantially above Exchange Value. The history of the uranium market would suggest that whenever contract prices become substantially out-of-phase with spot prices, one might expect to see renegotiation or

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[1] DOE NE-0013, "Survey of United States Uranium Marketing Activity," June 1981.

[2] DOE Release No. 80-155 "DOE reports results of uranium price surveys," October 1980.

[3] DOE RA-0053, "Survey of United States Uranium Marketing Activity," July 1980.

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cancellation of contracts, or even litigation. These activities occurred extensively after prices rose in the early 1970's. Similar events may be commencing now that prices have fallen. For example, Getty Oil Co. recently announced an agreement with two groups of purchasers, whereunder two long term supply contracts were terminated. Discussions involving other long term contract renegotiations have also taken place. While it is too early to predict a trend in this area, the driving forces for renegotiations are evident. This is significant because Nuexco's previously published estimates of US uranium production were based on the assumption that most existing long term supply contracts would remain in force, especially output-type contracts. Of course, any significant renegotiations of existing contracts would likely result in further decreases in estimated US production.

Also indicative of this retrenchment of the US uranium industry is additional data published in the recent DOE Report. US buyers contracted with US primary producers for an additional 25 million pounds of US origin U_3O_8 during 1980. However, those new commitments were more than offset by a 51.2 million pound reduction in delivery commitments under previous contracts, resulting in a net decrease of 26.2 million pounds of total future commitments. This is the first year in which reduction of commitments exceeded new procurement. In addition, uncommitted uranium estimated by US producers to be available for sale, as published in the DOE Report, has decreased over the last two years, as shown in Table 7. This estimate also indicates reduced production plans. In fact, much of the material listed in Table 7 will likely not be produced at all.

Table 7

UNCOMMITTED URANIUM ESTIMATED BY US PRODUCERS TO BE AVAILABLE FOR SALE[1]
(Millions of Pounds U_3O_8)

Year of Delivery	As of 1/1/79	As of 1/1/80	As of 1/1/81
1981	8.0	6.2	5.0
1982	13.4	8.6	5.6
1983	16.8	14.2	8.4
1984	20.2	15.6	11.0
1985	21.0	17.6	13.6

[1] Source: DOE NE-0013 "Survey of United States Uranium Marketing Activity," June 1981.

CONVERSION

The **Conversion Value** dropped to $1.10 per pound U from the previous month's level of $1.15 per pound U. There are no secondary market conversion transactions reported this month. However, one transaction involving a substantial quantity of near term conversion services is near closing. The price being discussed is a little below current Conversion Value. There continues to be downward pressure in the secondary market because inventory sellers must offer attractive prices to get the attention of the limited number of potential buyers.

As indicated in the *Market Opportunities* section of this Report, the total of secondary market conversion services available for near-term sale is about 1.9 million pounds U. Total near-term demand is 450 thousand pounds U.

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TOPICAL ESSAY

UNCONVENTIONAL TRANSACTIONS: PART THREE, BARTERS

This essay is the final installment in a three part series on unconventional transactions. The basic premise of these essays has been that in times of extreme supply-demand imbalances, high interest rates, excess inventories, and rapidly changing prices, unusual mechanisms must sometimes be developed to optimize selling, buying, and inventory handling strategies. The subjects of the first two essays were inventory upgrading and uranium options; in this essay fuel bartering is discussed.

Fuel bartering is simply the exchange of uranium for any other fuel source such as oil, coal, or natural gas. One party desiring to sell uranium and wanting to obtain another fuel would exchange its uranium for the fuel desired. A second party desiring uranium but wishing to sell another fuel exchanges its fuel for the first party's uranium.

Barter Candidates

The most likely candidates to participate in a fuel barter will fall into one of two categories. The first will be a utility which uses both uranium and an additional fuel, but has an imbalance of inventory in one or the other. For example, the utility may have both nuclear and oil fired electrical plants, and have too much uranium but not enough fuel oil. Alternately, the utility may have too little uranium but an excess of fuel oil.

The second candidate will be a producer or possibly a trader with dealings in both uranium and another fuel. This producer may desire to sell one of the fuels and have either a need for or the ability to dispose of the other fuel. For example, an oil company which has uranium production for sale would be able to barter uranium for oil, which it could in turn either use to fill its existing oil commitments or sell to another party through its established sales channels.

For purposes of this discussion it is assumed that a typical barter combination would be an oil company with uranium for sale and a utility with a need for uranium but with excess oil, due to decreasing load growths and the current glut in the oil market.

Advantages

The advantage to each party in bartering rather than merely selling their oil and uranium stocks stems from the fact that one of the most difficult aspects of a normal uranium sale at this time is getting the parties to agree on price. With a barter transaction, this potential source of disagreement is partially eliminated. With two commodities under consideration, there are two prices and thus two variables. Rather than agreeing on both prices, it is only necessary to agree upon an exchange *ratio*, that is, the number of pounds of uranium to be bartered for a barrel of oil or a ton of coal.

Figure 1 shows this concept graphically for an oil to uranium barter. The horizontal axis represents the price of oil in US dollars per barrel as valued by one of the parties. The vertical axis represents the uranium price in US dollars per pound U_3O_8 as valued by one of the parties. The diagonal lines are constant ratio lines where the relative value of the uranium compared to the value of the oil remains the same. For example, the uranium owning party may wish to value its uranium at $25.00 per pound U_3O_8 but may not be sensitive about the value of oil. Thus it might propose a ratio of 0.79 bbl oil per pound U_3O_8. The other party may wish to value the incoming uranium at $20.00 per pound U_3O_8. By valuing its oil at $27.50 per bbl oil, the second party may still agree with the ratio proposed by the first party, and in fact strike a deal, despite the fact that the two sides have not reached a consensus on the value of the uranium.

Not only does this aspect of a barter make the contract easier to negotiate, but there may be other advantages to this "disguising" of the actual price. Specifically:

1. If the uranium or oil has been purchased at a low price relative to today's market, there may be income tax advantages because the barter may be viewed as a tax free exchange of like property. Conversely, if the material was purchased by a utility at a high price and the utility is having difficulty selling because of required Public Utility Commission approval to sell at a lower price, a barter may be an effective way to do so.
2. Both the oil and uranium markets are currently experiencing a glut, with resultant stagnant or declining prices. A fuel barter will possibly avoid contributing to a further decline in prices.
3. A fuel barter can potentially create a long term uranium contract with an up-front payment. In the current uranium market it is virtually impossible for the seller of uranium to be paid in advance of delivery. However, if a utility wishing to procure uranium possesses excess oil stocks, it may elect to turn these stocks over to an oil company in exchange for future

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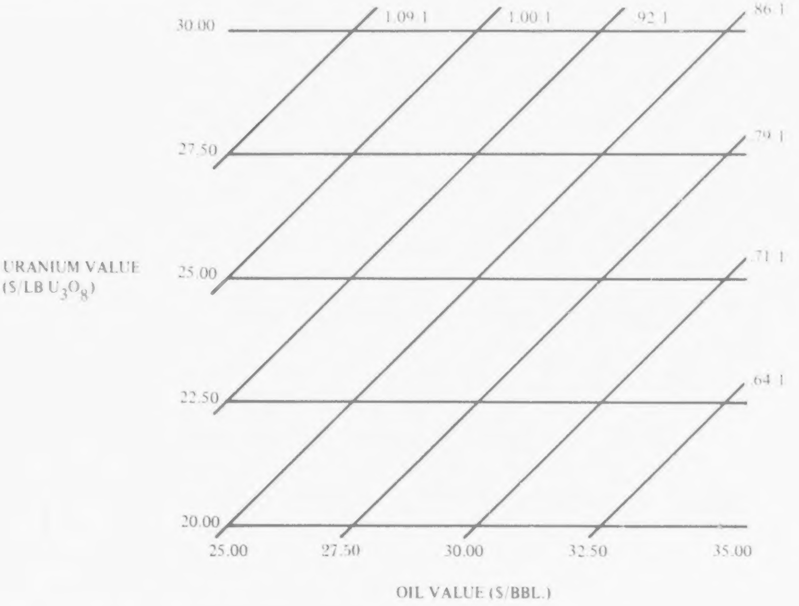

Figure 1

CONSTANT RATIOS FOR DIFFERENT URANIUM AND OIL VALUES (RATIOS EXPRESSED AS BBL. OIL/LBS. U_3O_8)

delivery of uranium. This is in effect a payment in advance, and the parties would probably make some concession in the exchange ratio to reflect the advantage of the advance payment to the uranium supplier. This type of transaction may appeal to both sides. The utility obtains an attractive long term uranium contract as well as immediate value from the funds currently lying idle in excess oil stocks, while the oil company receives a long term uranium contract with advance payment.

Terms

A barter transaction differs from a typical sales contract as far as the crucial terms are concerned. The primary terms include:

1. The specifications of the alternate fuel. Coal and oil have specifications that affect the quality of the material and vary widely from lot to lot. Btu content, sulfur content, viscosity, ash, and other specifications must be predetermined in order to assess the relative value of the fuel being bartered.
2. The ratio of uranium per unit of alternate fuel bartered.
3. The delivery point. For uranium, this is not a particularly difficult matter, since transportation costs for uranium are not significant. However, for coal and oil, transportation costs may be a large part of the total cost, and may in some cases even exceed the cost of the material itself.
4. Delivery times. If one fuel is to be delivered at a different time from the other, the party delivering earlier may be credited with an appropriate altering of the exchange ratio

As with inventory upgrading (Topical Essay, Nuexco Report 155) and uranium options (Topical Essay, Nuexco Report 156), the main advantage in bartering is the increased flexibility it gives the parties in addition to the potential economic advantages. It is not surprising that the recent turmoil in the uranium market has given rise to the consideration of these unconventional transactions.

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ESSAY

NPT UPDATE

The June 1981 Bulletin of the International Atomic Energy Agency (IAEA) lists 111 non-nuclear-weapon States which are party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). With the addition of three of the five nuclear-weapon State signatories, the US, United Kingdom and Union of Soviet Socialist Republics, the NPT member total is 114. France and the People's Republic of China are the remaining nuclear-weapon States but they have not signed the NPT.

Since the end of 1979, Barbados, Turkey and Egypt (all non-nuclear-weapon States) have joined the list of NPT signatories. Egypt is the newest addition to the group and became party to the NPT on February 26, 1981. Egypt's ratification was viewed as opening the door for French reactor sales and also as reopening negotiations with Westinghouse Electric Corp. for additional sales.

Under the terms of the NPT, a nation which signs the Treaty must submit instruments of ratification or accession from its national government to the NPT depositary nations: the US, UK and USSR. Each non-nuclear-weapon State signatory is also required to execute an agreement with the IAEA. This agreement provides the framework for implementation of the safeguards specified under the Treaty. As of May 14, 1981, the IAEA had negotiated safeguards agreements with 78 of the 111 non-nuclear-weapon States party to the NPT. Safeguards agreements were in force with 69 of these States. Indonesia, Libya and Senegal are the most recent addition to the 69, having brought their NPT safeguards agreements into force during 1980. The other nine safeguards agreements had been approved by the IAEA Board of Governors and were awaiting entry into force.

There are many cases where non-nuclear-weapon States have signed the NPT but have not concluded the relevant safeguards agreement with the IAEA. Some of these agreements are more than ten years overdue. However, the IAEA is continuing efforts towards their completion. As far as the Agency is aware, there is no nuclear material or nuclear activity in any of these States that would require the practical application of safeguards, with the exception of one State in which the activity is covered by a non-NPT safeguards agreement.

Nations which have not signed the NPT can enter into safeguards agreements with the IAEA which cover all or part of the countries' nuclear activities. By placing their nuclear activities under IAEA inspection with the agreements, these nations are allowed access to nuclear materials. NPT members are not permitted to transfer nuclear material, including natural uranium, to non-nuclear-weapon States unless that material is subject to IAEA inspection in the recipient State, whether or not that State is a party to the NPT.

Spain is a recent example of this. Although Spain has not yet acceded to the NPT, all of its nuclear facilities were, for the first time, placed under Agency safeguards with the signing of two safeguards agreements in Vienna on April 1 of this year. The agreements entered into force on May 11. The US State Department followed the signing with approval for the issuance of export licenses for low-enriched fuel destined for Spain.

In 1980 IAEA safeguards agreements were in force with 11 non-nuclear-weapon States which had not signed the NPT: Argentina, Brazil, Chile, Colombia, Cuba, the Democratic People's Republic of Korea (North Korea), India, Israel, Pakistan, South Africa and Spain. The agreements with Argentina, Brazil, Chile, Colombia, Cuba, the Democratic People's Republic of Korea and Spain covered all substantial nuclear activities, present or future, of which the Agency was aware. In the other countries, unsafeguarded nuclear facilities were in operation or under construction.

Safeguards are actually being enforced in those countries where nuclear activities have reached the stage at which reports and verification actions are required under the existing agreements. The number of installations under safeguards increased during 1980 from 700 to 744. Most of the material under safeguards (92 percent of total plutonium and 94 percent of total uranium) in 1980 was located in States which had submitted all their peaceful nuclear activities to safeguards. The quantities of safeguarded nuclear material changed in 1980 as follows: separated plutonium decreased 38 percent to five tonnes; plutonium contained in spent fuel rose by 30 percent to 78 tonnes; highly enriched uranium increased 18 percent to 13 tonnes; low-enriched uranium rose 18 percent to 13,872 tonnes, and source material rose 24 percent to 19,097 tonnes.

Table 8 represents a summary of the NPT status and bilateral agreements status of those nations with near term potential to purchase or sell uranium.

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Table 8

Nation[1]	NPT Member	Has Safeguards Agreement in Force With the IAEA	Has Bilateral Agreement With United States For Nuclear Power[3]	Has Bilateral Agreement With Canada	Has Bilateral Agreement With Australia
Algeria					
Argentina		X	X	X[9]	
Australia	X	X	X[6]	X	
Austria	X	X	X		
Belgium	X	X	X	X	
Brazil		X	X		
Bulgaria	X	X			
Canada	X	X	X[6]		X
China, People's Republic of					
Czechoslovakia	X	X			
Denmark	X	X	X	X	
Egypt	X		X[8]		
Finland	X	X	X	X	X
France			X	[7]	X[11]
Gabon	X				
German Democratic Republic	X	X			
Germany, Federal Republic of	X	X	X	X	
Hungary	X	X			
India		X[2]	X		
Indonesia	X	X	X[10]		
Iran	X	X			
Iraq	X	X			
Ireland	X	X	X	X	
Israel		X[2]			
Italy	X	X	X	X	
Japan	X	X	X	X	
Korea, Republic of	X	X	X	X	X
Luxembourg	X	X	X	X	
Mexico	X	X	[4]		
Netherlands	X	X	X	X	
Niger					
Norway	X	X	X[10]		
Pakistan		X[2]			
Philippines	X	X	X	X	X
Poland	X	X			
Portugal	X	X	X		
Romania	X	X		X	
Saudi Arabia					
South Africa Namibia		X[2]	X		
Spain		X	X	X[9]	
Sweden	X	X	X	X	X
Switzerland	X	X	X		
Taiwan (Republic of China)	X		X		
Thailand	X	X	X		
Turkey	X		X		
Union of Soviet Socialist Republics	X				
United Kingdom	X		X	X	X
United States	X			X	X
Venezuela	X		X[5]		
Yugoslavia	X	X	[4]		

(Footnotes on following page)

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Footnotes to Table 8

[1] Only nations with near term potential to purchase or sell uranium are included. The five nuclear weapon States are listed in italics.

[2] Not all nuclear facilities are covered under safeguards agreement.

[3] Only agreements regarding power generation are included. The US has agreements with other nations regarding nuclear research, but those are not included. Egypt, Israel, Iran and Greece hold long-term, fixed-commitment enrichment contracts with the US, which can be implemented only after bilateral safeguards agreements have been signed.

[4] There are special agreements whereunder the US supplies uranium for specific projects to Mexico and Yugoslavia through the IAEA. All such uranium is subject to IAEA safeguards.

[5] Agreement expired in 1980.

[6] Renegotiated bilateral agreement in force.

[7] Only allows the enrichment of Canadian material for use in other Euratom countries.

[8] Agreement has been signed by President Reagan and is expected to enter into force this year.

[9] New agreements have been negotiated, but cannot be signed until compliance with safeguards requirements. Arrangements for trade under existing contracts are continuing.

[10] Renegotiations of revised bilateral agreement are complete.

[11] Safeguards agreement negotiated but not yet in force.

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SPANISH NUCLEAR PROGRAM — PART II

Regional Geology

The geomorphology of Spain consists primarily of broad mountain chains and high plateaus which were developed during two distinct periods of regional tectonics. The first tectonic event was the Hercynian (Upper Carboniferous Period) which has been age-dated at 325 to 350 million years. The main geologic feature developed at that time was the Central Iberian Mountain Zone which occupies a large portion of west-central Spain. It is one of Spain's most important mineralized belts, especially for uranium.

The second tectonic event was the development of the Alpine Mountain Chains which parallel the south and southeast coastal areas as well as the Spanish French border. All Alpine tectonics occurred during Cretaceaous and Early Tertiary time which dates from about 135 to 65 million years. The Alpine Mountain Chains contain a number of uranium occurrences, but each is of rather limited size and a development schedule is uncertain.

During the mountain building process, the intervening low-lands were uplifted to form the high plateaus common throughout the Spanish interior. The plateau regions, or mesetas, experienced continuing transformation through heavy erosion and structural subsidence well into Tertiary times. As a result, the mesetas collected varying thicknesses of coarse to fine Tertiary sediments basinward. The source of the sedimentary material was the older rocks which eroded from the surrounding mountains. The Early Tertiary sediments filling the basins and the deeper Triassic and Jurassic rocks are considered favorable hosts for uranium mineralization. Figure 2 shows the principal mountain chains and sedimentary basins of Spain.

Uranium Geology

The basal geology of most mountain chains in Spain includes a sequence of Precambrian strata consisting of bedded sandstone, quartzites and dolemites that has been thrust upward to form broad folds. A thick Paleozoic sequence unconformably overlies the older rocks. The entire Paleozoic section has been folded and faulted to make up the present high mountain terrain. Metamorphism of all formations is a local feature associated with irregular and sometimes massive intrusions of Hercynian granites. Important uranium mineralization is associated with Cambrian slates at the base of the Paleozoic sequence and Hercynian granites, primarily in the Central Iberian Mountain Zone. Uranium mineralization in the Alpine fold belts is limited to minor occurrences in Lower Paleozoic rocks.

The geologic history of the mesetas is revealed in areas where extensive erosion has taken place. The Paleozoic sequence overlies Precambrian basement rocks. The Paleozoic strata in turn is overlain by Mesozoic deposition consisting of Triassic, Jurassic and Cretaceous sediments. Each formation shows evidence of folding and faulting associated with mountain building tectonics. The general attitude of the formations shows steep dips which are adjacent to mountain fronts. However, all structural features moderate basinward. Tertiary sediments deposited directly on the eroded surface of Paleozoic and Mesozoic rocks are generally flat-lying, but minor folds and faults show the effects of late Alpine Tectonics.

There are three principal Tertiary basins in Spain representing an area of approximately 100,000 square kilometers; each is considered to be geologically favorable for uranium mineralization in Tertiary and Mesozoic rocks. The Ebro basin, situated between the northeast southwest trending Iberian and Pyrenees Mountain Chains, may be the deepest of the three. Tertiary sediments are known to exceed 3300 meters in the northwest part of the basin. Uranium mineralization has been noted along the mountain flanks on both sides of the basin.

The Duero Basin may be the largest of the three. It is surrounded by the Cantabrian Mountains on the north, the Central Iberian Zone on the west and south and the Iberian Chain on the east. The thickness of the Tertiary cover varies throughout the basin. Uranium mineralization has been discovered in Mesozoic rocks along the western edge of the basin. Much of the basin interior remains to be explored.

The Tajo Basin extends southward from Madrid about 130 miles to the northern extremity of the Betic Mountain Chain and is limited to the west by the Central Iberian Zone. Although the Tertiary sediments filling the basin represent favorable exploration targets, known uranium occurrences are limited to the eastern flanks of the Central Iberian Zone and the recent discovery of Mazarete.

Spain's Empresa Nacional del Uranio S.A. (ENUSA) has an extensive exploration program planned for the three basin area. Eocene and Miocene sediments represent the likely host formations within the basin

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interiors. Paleozoic and Mesozoic sediments are favorable host targets along the mountain fronts where the Tertiary cover is relatively thin or completely removed by erosion. The ore at Mazarete, Guadalajara was discovered on outcropping Jurassic sandstone along the eastern edge of the Tajo Basin. Drilling results indicate that the mineralization extends down-dip. It now appears to be an important discovery and ENUSA is planning to increase exploration in the area. However, most uranium occurrences are found in older rocks along the mountain fronts where Cambrian slates and Hercynian granites outcrop. The important ore occurrences at Ciudad Rodrigo in Salamanca Province occur in this environment.

Ciudad Rodrigo Project

Uranium mineralization was discovered in the vicinity of Ciudad Rodrigo, Province of Salamanca, in the 1960's by the state-owned Junta de Energia Nuclear (JEN). A number of mineral occurrences were noted in Cambrian slates and Hercynian granites along the northeast front of the Central Iberian Mountain Zone. JEN continued exploration in the district and subsequently established a uranium reserve of about 5000 tonnes U_3O_8. Jurisdiction over the ore deposits was transfered to ENUSA in 1973. Exploitation of the deposits by ENUSA began in 1974. At the same time ENUSA began detailed exploration throughout the Ciudad Rodrigo district. Since 1976, the exploration program has spread to include much of the mountain frontal areas in western Salamanca Province. Exploration progressed rapidly with the utilization of the latest geophysical and geochemical techniques.

The exploitation effort has met with considerable success. Total uranium reserves are now estimated by ENUSA at 16,700 tonnes U_3O_8. The estimate of exploitable reserves is 15,500 tonnes U_3O_8 at a grade of 0.07 to .10 percent, most of which occur at the Mina FE location. Additional radioactive anomalies and mineral occurrences have been located in the district and are presently being evaluated. ENUSA's main exploration efforts continue to be centered in the Salamanca district.

Approximately 80 percent of exploitable reserves in Spain are located in the western mineral zone of the Salamanca district. The uranium mineralization commonly occurs in igneous and metamorphic rocks of the Paleozoic sequence. About 90 percent of the ore reserves occur in a highly fractured segment of Cambrian slates. Secondary uranium minerals have concentrated on fracture surfaces in a zone that is 30 to 50 meters thick. The mode of mineralization resembles a typical enrichment blanket whereby the slates above and below the blanket are almost completely barren of uranium. The Cambrian strata above and below the slate consists of alternating carbonaceous beds and quartzitic conglomerates of which none are mineralized.

The remaining ten percent of mineralization occurs as primary uranium minerals (coffinite and pitchblende) in veins and fractures within Hercynian granites. It is not uncommon to find traces of uranium in the Tertiary sediments closely associated with mineralized older rocks. In fact, radioactive anomalies in Tertiary sediments are a useful exploration guide to underlying Paleozoic mineralization.

The source of uranium mineralization is considered to be the Hercynian granites. Highly disseminated uranium was leached from the granites by the process of oxidation which occurred during extensive periods of alteration and weathering. The uranium-bearing solutions migrated along faults and fractures. The uranium was precipitated in a reducing environment throughout the favorable host rocks.

Exploitation activities are centered around the Mina FE location. The Mina FE mine is the principal source of ore, however lesser amounts are mined from small satellite deposits within the district. All mining is open-pit. Figure 3 is an aerial view of the Mina FE mine area.

Following the mining, the ore is crushed to about 2.5 cm. It is then stacked in large rectangular piles for heap-leaching by the controlled application of acid. Figure 4 is an aerial view of the heap-leach facilities. Annual production from the operation averages 130 tonnes U_3O_8. The production facility will be expanded to 600 tonnes U_3O_8 per year by 1985 or 1986. ENUSA believes that the Ciudad Rodrigo project will continue to be the principle source of domestic uranium.

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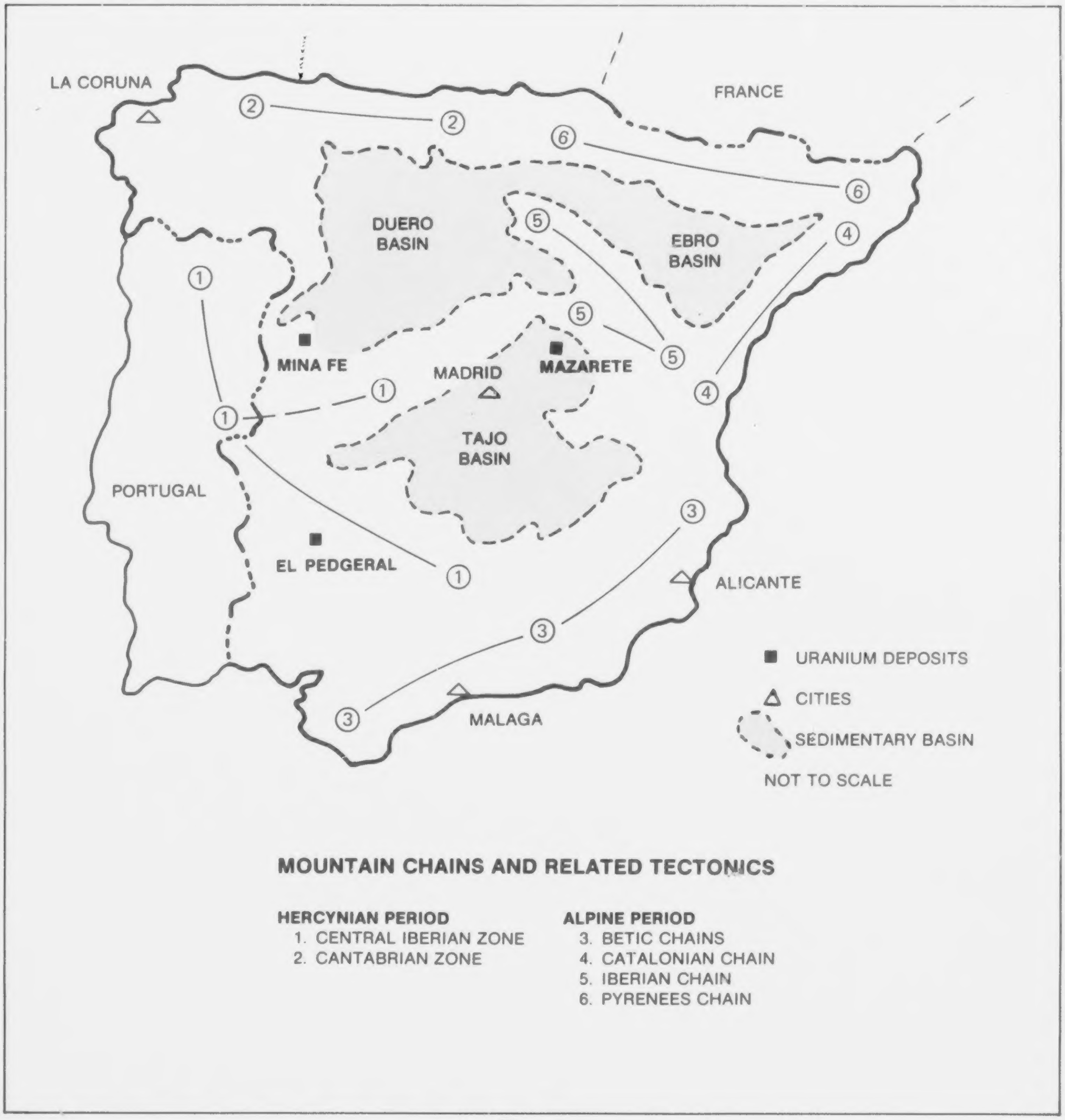
LA CORUNA
FRANCE
DUERO BASIN
EBRO BASIN
TAJO BASIN
PORTUGAL
MINA FE
MADRID
MAZARETE
EL PEDGERAL
ALICANTE
MALAGA
① ② ③ ④ ⑤ ⑥
■ URANIUM DEPOSITS
△ CITIES
SEDIMENTARY BASIN
NOT TO SCALE
MOUNTAIN CHAINS AND RELATED TECTONICS
HERCYNIAN PERIOD
1. CENTRAL IBERIAN ZONE
2. CANTABRIAN ZONE
ALPINE PERIOD
3. BETIC CHAINS
4. CATALONIAN CHAIN
5. IBERIAN CHAIN
6. PYRENEES CHAIN

Figure 2
LOCATION OF PRINCIPAL
MOUNTAIN CHAINS, SEDIMENTARY
BASINS AND URANIUM DEPOSITS IN SPAIN

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RAW MATERIALS

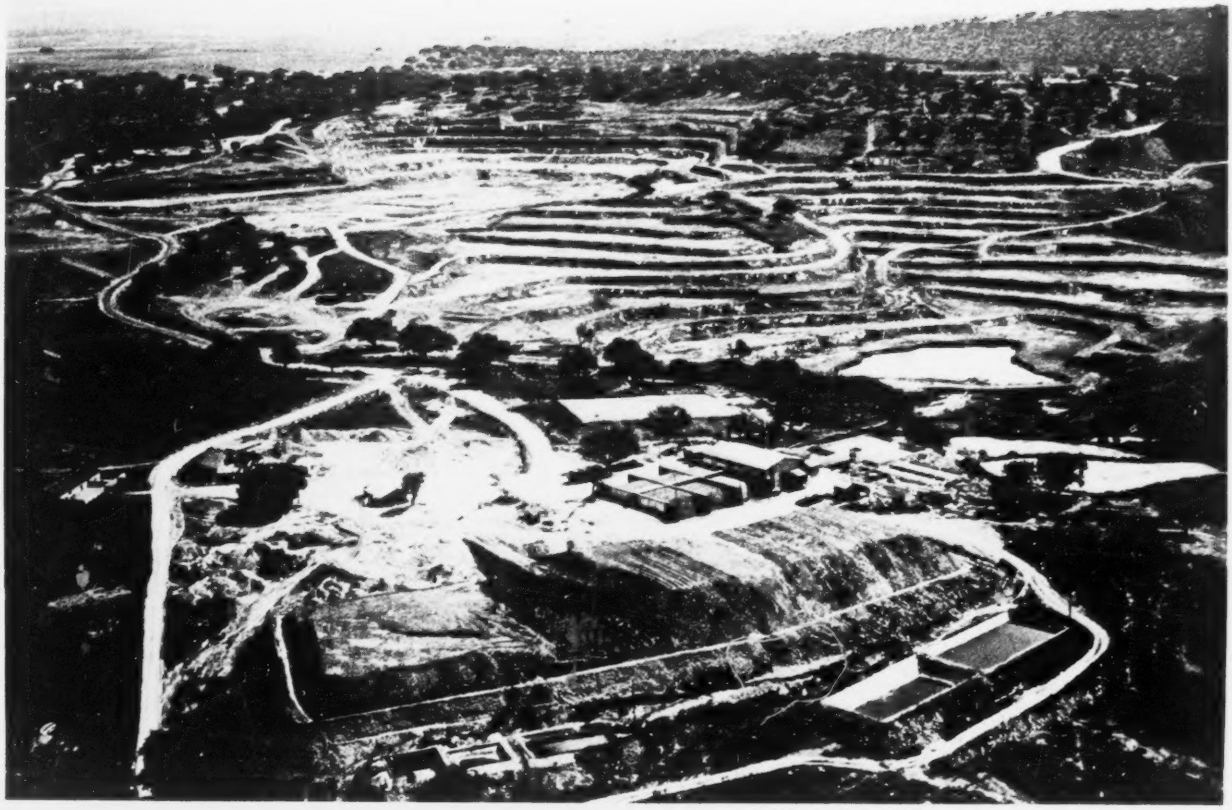

Figure 3

AERIAL VIEW SHOWING MINA FE MINING AND HEAP-LEACHING OPERATIONS, CIUDAD RODRIGO, SALAMANCA

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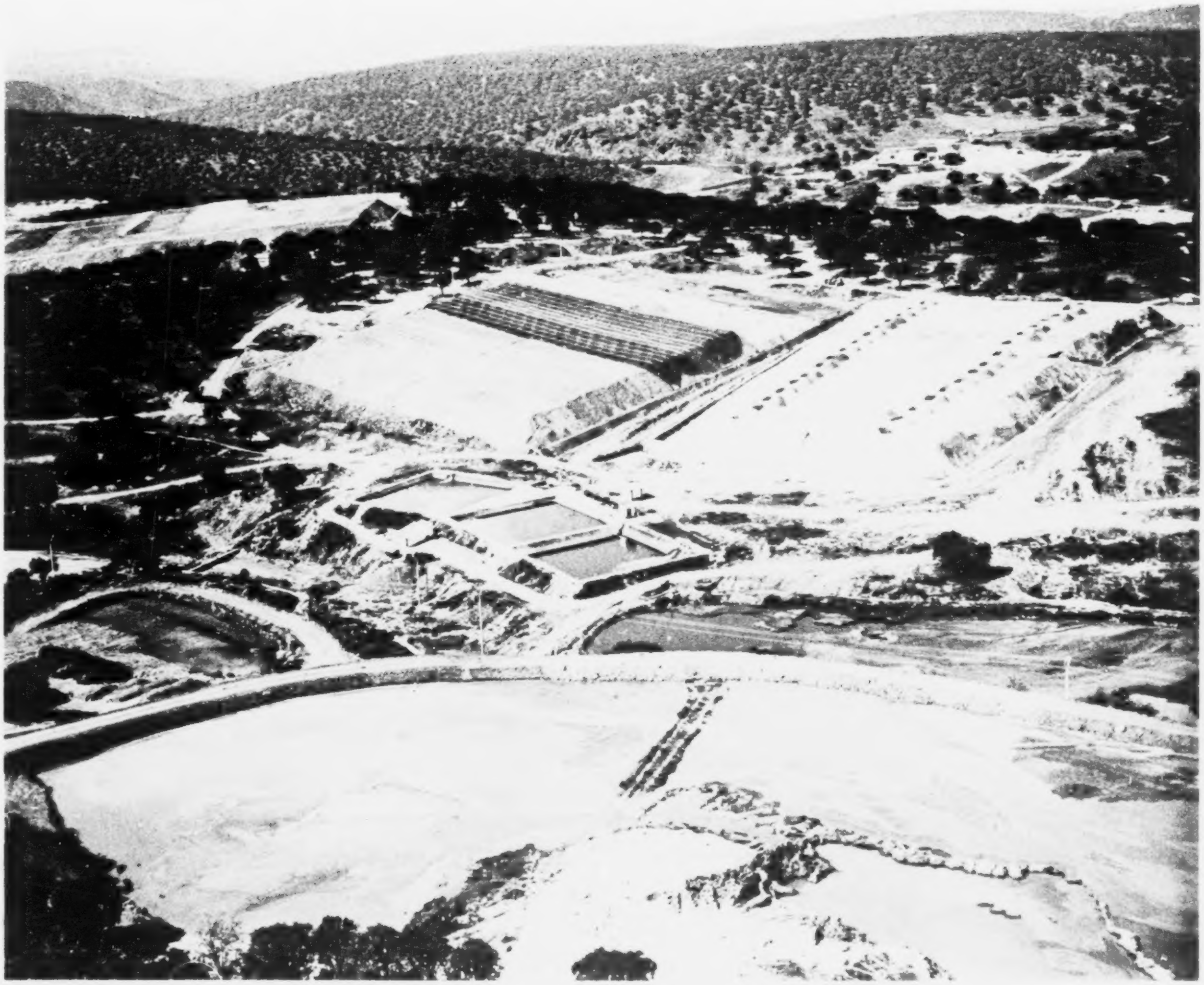

Figure 4

AERIAL VIEW OF MAIN HEAP-LEACHING OPERATION AT CIUDAD RODRIGO, SALAMANCA

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STATISTICAL DATA

EXCHANGE VALUE $23.50/lb. U_3O_8
Determined as of August 31, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.

B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of August 31, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
24.30	2.6	10	5

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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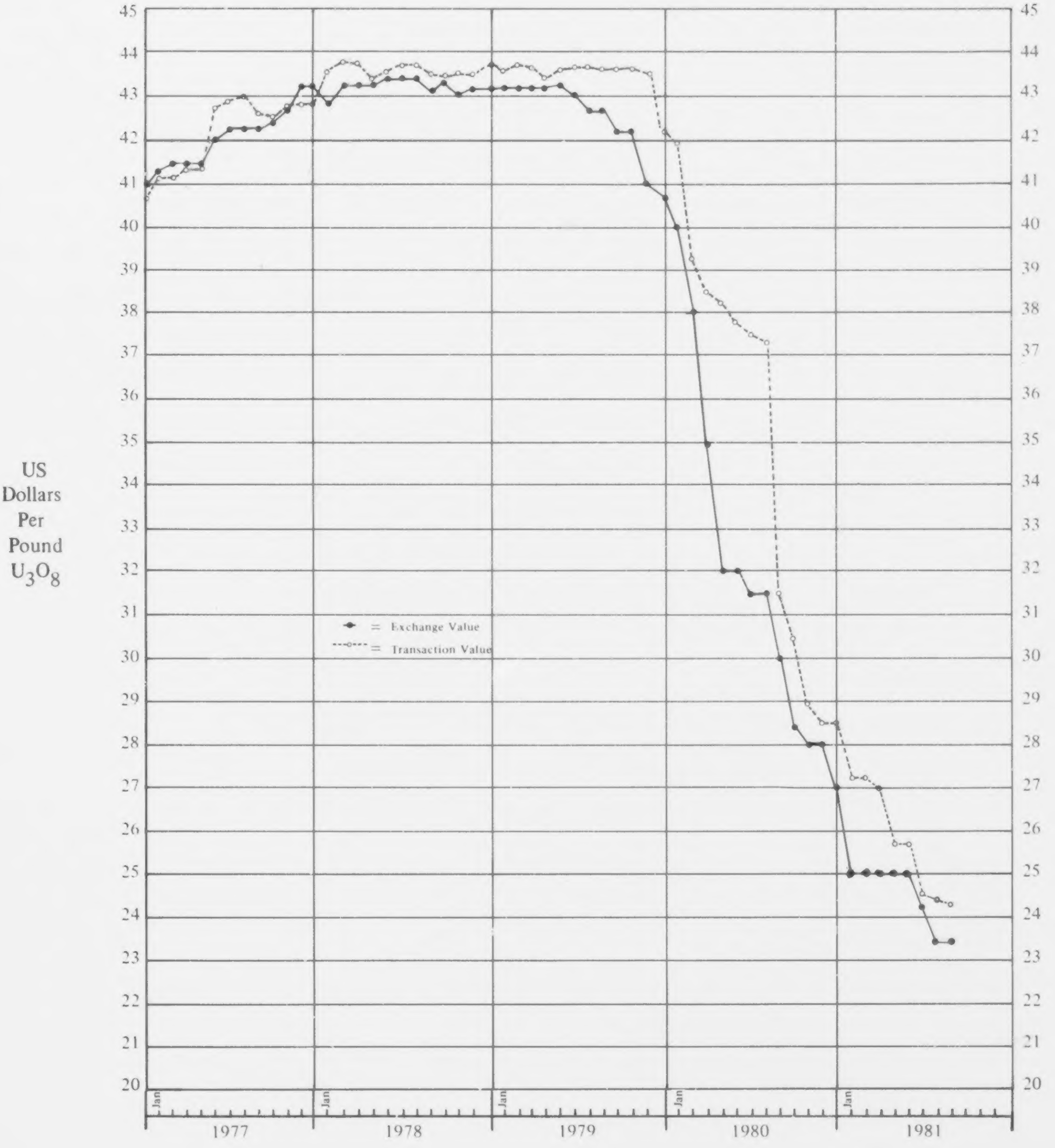
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50				

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30				

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
US (dollar)	23.50	51.81	61.09
France (franc)	137.35	302.80	357.07
FRG (mark)	57.53	126.83	149.56
Japan (yen)	5,370	11,839	13,961
Switzerland (franc)	49.97	110.16	129.91
UK (pound)	12.69	27.97	32.99
Australia (dollar)	20.43	45.04	53.11
Canada (dollar)	28.22	62.23	73.38
Niger, Gabon (CFA)	6,867	15,140	17,854
South Africa (rand)	22.17	48.88	57.64
Sweden (kröner)	123.23	271.68	320.37

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

CONVERSION VALUE $1.10/lb. U as UF$_6$
Determined as of August 31, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:
A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:
A. The price of conversion services delivered or to be delivered under old contracts.
B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

LOAN USE CHARGE RATE 5½%
Determined as of August 31, 1981

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:
A. Data from recently completed or pending loan transactions.
B. Rates included in firm proposals to borrow or lend.
C. Rates that potential borrowers and lenders have expressed as a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
Uranium Transactions						
1588	1981	Less than 50	108	US	Far East	
1592	1981	301-600	—	Canada	US	Definitive price information not available
1599	1982	101-300	115	US	US	
1602	1984-94	3001-6000	—	Canada	US	Price related to market

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as percent of Current C.V.	Seller Group	Buyer Group	Remarks
Conversion Transactions						

*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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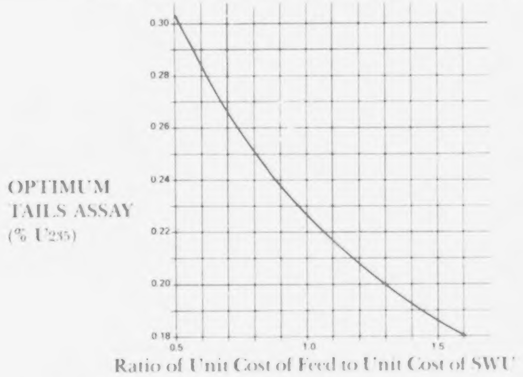
STATISTICAL DATA

OPTIMUM TAILS ASSAY

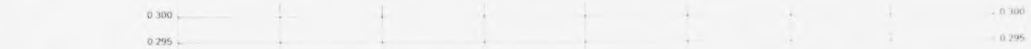
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
				Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
Ann. Avg. 1970(5)(7)	110.0	116.3	91.36	3.88	3.87	3.69	3.28
Ann. Avg. 1971(5)(7)	114.1	121.3	96.02	4.12	4.15	3.97	3.49
Ann. Avg. 1972(5)(7)	117.9	125.3	100.00	4.56	4.59	4.26	3.71
Ann. Avg. 1973(5)(7)	125.9	133.1	105.80	4.84	4.98	4.51	3.91
Ann. Avg. 1974(5)(7)	153.8	147.7	116.02	5.44	5.63	4.88	4.21
Ann. Avg. 1975(5)(7)	171.5	161.2	127.15	6.13	6.24	5.39	4.64
Ann. Avg. 1976(5)(7)	182.4	170.5	133.71	6.76	6.87	5.91	4.96
Ann. Avg. 1977(5)(6)(7)	195.1	181.5	141.70	7.28	7.67	6.43	5.39
Ann. Avg. 1978(5)(6)(7)	209.4	195.4	152.05	8.23	8.56	7.02	5.82
Ann. Avg. 1979(6)(7)	236.5	217.4	165.46	9.27	9.50R	7.60	6.32
Ann. Avg. 1980	274.5	246.8	177.36	10.27R	10.63R	8.30R	6.95R
Apr 1980	271.3	242.5	–	10.01R	10.31R	8.13R	6.78R
May 1980	271.9	244.9	–	10.19R	10.38R	8.18R	6.77R
Jun 1980	273.5	247.6	178.93	10.14R	10.70R	8.25R	6.86R
Jul 1980	276.2	247.8	–	10.24	10.83R	8.36R	6.95R
Aug 1980	278.2	249.4	–	10.39R	10.79R	8.40R	7.01R
Sep 1980	278.8	251.7	182.92	10.55R	10.95	8.47R	7.12R
Oct 1980	282.2	253.9	–	10.59R	11.01	8.53R	7.18R
Nov 1980	283.4	256.2	–	10.73	11.07	8.60R	7.27R
Dec 1980	286.6	258.4	183.98	10.84R	11.32	8.69R	7.38R
Jan 1981	291.5	260.5	–	10.91	11.31	8.74	7.41
Feb 1981	295.7	263.2	–	11.15	11.36	8.80	7.43
Mar 1981	299.6R	265.1	188.14	11.13	11.50	8.84	7.47
Apr 1981	302.8	266.8	–	11.30	11.63	8.94	7.51
May 1981	304.1	269.0	–	11.26	11.68	8.99	7.55
Jun 1981	304.7	271.3	–	11.30P	11.87P	9.08P	7.57P
Jul 1981	306.0P	274.4P	191.17	–	–	9.16P	7.53P

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for January 1977 and beyond are adjusted to the March 1979 benchmark.

(5) Monthly data 1970-1978 for Price Indexes and Employment and Earnings SIC-codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.

(6) Monthly data 1977-1979 for Employment and Earnings SIC codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.

(7) Monthly data 1970-1979 for Employment and Earnings SIC code 36 appear on page 23 of Nuexco Report 154.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970 (3)	101.4	59.88
Annual Avg. 1971 (3)	101.5	65.95
Annual Avg. 1972 (3)	105.6	71.26
Annual Avg. 1973 (3)	124.4	78.96
Annual Avg. 1974 (3)	141.9	108.07
Annual Avg. 1975 (3)	150.4	132.55
Annual Avg. 1976 (3)	168.4	160.93
Annual Avg. 1977 (3)	192.0	179.03
Annual Avg. 1978 (3)	198.5	190.04
Annual Avg. 1979	248.8	196.34
Annual Avg. 1980	321.8	217.96R
Apr 1980	328.4	215.14
May 1980	335.6	214.81
June 1980	338.8	214.16R
Jul 1980	347.8	221.51R
Aug 1980	352.0	220.08R
Sep 1980	350.3	219.60R
Oct 1980	348.2	221.13R
Nov 1980	350.4	221.49R
Dec 1980	351.7	221.81R
Jan 1981	357.8	229.96R
Feb 1981	356.6	229.79R
Mar 1981	355.2	229.03R
Apr 1981	354.6	228.75R
May 1981	353.4	236.67
Jun 1981	360.3P	236.98P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra; "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra; "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 1.7 and 1.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Annual Avg. 1980	247.2	10.59	8.05	8.50
Apr 1980	241.1	10.40	7.94	8.36
May 1980	242.4	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.4	10.58	8.14	8.65
Sep 1980	252.0	10.85	8.24	8.71
Oct 1980	256.0	11.05	8.28	8.82
Nov 1980	257.7	11.11	8.38	8.77
Dec 1980	258.4	11.13	8.32	8.92
Jan 1981	263.3	11.27	8.51	8.90
Feb 1981	263.6	11.43	8.59	9.00
Mar 1981	265.4	11.47	8.63	9.17
Apr 1981	267.7	11.72P	8.76P	9.33P
May 1981	269.6	—	—	—
Jun 1981	271.9P	—	—	—

P = Preliminary   R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa, "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)	Total Employment in Mining and Quarrying (Code 35)[5]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[5]
Annual Avg. 1970 (3)	7.34	100.3(4)		655,346	399,164
Annual Avg. 1971 (3)	7.88	106.4(4)	59.1	652,294	415,956
Annual Avg. 1972 (3)	8.79	113.3(4)	63.9	623,067	443,933
Annual Avg. 1973 (3)	10.51	124.1(4)	72.3	684,743	572,133
Annual Avg. 1974 (3)	13.18	138.5(4)	85.3	674,140	761,596
Annual Avg. 1975 (3)	16.71	157.2(4)	100.0	639,473	1,003,617
Annual Avg. 1976 (3)	19.30	174.7(4)	115.1	671,240	1,212,983
Annual Avg. 1977 (3)(6)	23.87	194.4(4)	130.0	712,006	1,420,670
Annual Avg. 1978 (3)(6)	27.14	137.2	142.7	664,571	1,537,169
Annual Avg. 1979 (3)(6)	30.18	155.3	164.5	692,209	1,830,632
Annual Avg. 1980 (6)	35.53	176.7	192.1	714,379	2,279,615
Apr 1980	–	170.0	184.2	710,652	169,415
May 1980	–	171.9	187.0	717,171	179,128
Jun 1980	34.48	174.6	189.0	714,379	183,739
Jul 1980	–	177.2	192.7	715,460	202,403
Aug 1980	–	179.2	196.8	716,486	206,514
Sep 1980	36.19	182.8	199.8	710,889	204,761
Oct 1980	–	186.3	203.1	720,246	204,602
Nov 1980	–	187.8	205.6	716,797	208,345
Dec 1980	37.69	189.9	206.5	705,087	211,829
Jan 1981	–	191.0	207.2	729,575	219,969
Feb 1981	–	193.8	209.8	725,647	210,275
Mar 1981	39.26	195.2	209.9	705,010	210,151
Apr 1981	–	196.4	211.6	719,674	217,124
May 1981	–	197.7	213.2	726,869	219,880
Jun 1981	40.41	200.0	215.3	728,506	237,049
Jul 1981	–	204.6	218.4	–	–

(1) Chamber of Mines of South Africa, Johannesburg; "Analysis of Working Results," published quarterly.
(2) Republic of South Africa Department of Statistics, Pretoria; "Government Gazette: Consumer Price Index for Urban Areas."
(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Nuexco Report 140.
(4) April 1970 = 100.00.
(5) Bulletin of Statistics, Department of Statistics, Pretoria.
(6) Historical data for Codes 35 and 40 1977-1980 appear in this report.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

Total Employment in Mining and Quarrying (Code 35)[1]

Month	1980	1979	1978	1977
Jan	699,112	664,394	620,146	623,207
Feb	705,758	680,054	660,111	702,511
Mar	708,456	689,770	658,059	706,614
Apr	710,652	682,505	660,075	700,532
May	717,171	689,749	666,478	715,410
Jun	714,379	692,209	664,571	712,006
Jul	715,460	699,567	670,164	707,953
Aug	716,486	692,377	673,505	707,521
Sep	710,889	686,248	670,864	713,117
Oct	720,246	692,859	675,595	707,092
Nov	716,797	699,158	674,717	692,430
Dec	705,087	697,741	662,418	663,668
Ann Avg.	714,379	692,209	664,571	712,006

Total Salaries and Wages in Mining and Quarrying (Code 40)[1]
(R 1000)

Month	1980	1979	1978	1977
Jan	171,548	137,630	117,298	104,876
Feb	165,790	136,252	116,252	108,702
Mar	171,573	139,717	121,582	114,713
Apr	169,415	143,812	116,945	117,467
May	179,128	146,732	124,990	118,499
Jun	183,739	152,862	126,343	118,114
Jul	202,403	161,450	134,330	117,022
Aug	206,514	159,514	136,428	121,280
Sep	204,761	158,804	132,700	125,491
Oct	204,602	162,721	135,434	125,597
Nov	208,345	165,956	136,928	124,607
Dec	211,829	165,182	137,561	124,366
Ann. Avg.	2,279,615	1,830,632	1,537,160	1,420,670

(1) Bulletin of Statistics, Department of Statistics, Pretoria.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1393			350	
1475	1100			UF_6
1480	200	300	300	
1490	1100			
1550	600			
1562			150	Long Term
1575			500	Long Term
1581	100	150	150	Long Term
1600			200	Long Term
1610	300	100		
1637	500	500		
1678		275		
1684	500			
1685	100			
1698	130			
1727	500			
1730	30			
1738	750			UF_6
1740	500			
1741	500			
1742	200			
1743	100			
TOTAL:	7210	1325	1650	
Available for Loan:				
1429	300			UF_6
1646	275	275	275	
1695	225	325	325	UF_6
1742	500			
TOTAL:	1300	600	600	

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1459			200	Long Term
1462			100	Long Term
1603		100	100	Long Term
1634	400	400		
1636	200	200	200	
1650	220			
1699	1000			
1704		200	200	Long Term
1706	250			
1724	600	500	500	Long Term
1731	250			
1732	50			
1733	1000			
TOTAL:	3970	1400	1300	
Inquiries to Borrow:				
1621	300			
TOTAL:	300			

***Measured from the date of this Report.**

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF₆ conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1451	75			
1607	900			
1609	500	1500	1000	Long Term
1619		200	100	
1661		400	400	Long Term
1684	450			
TOTAL:	1925	2100	1500	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF6) 0 to 1 Year	1 to 2 Years	2 to 3 Years	Remarks
1594		400	950	Long Term
1622		400	400	Long Term
1722	450			
TOTAL:	450	800	1350	

*Measured from the date of this Report.

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 157

The **Exchange Value** remained at $23.50 per pound U_3O_8 for the second consecutive month. Over one million pounds U_3O_8 is under serious negotiation at prices near current Exchange Value. In addition, many sellers are offering or appear willing to offer large amounts of material at this level.

Near term supply and near term demand are approaching the same order of magnitude for the first time in many months. Active inquiries to sell in the spot and near term market increased this month and amount to 7.2 million pounds U_3O_8 equivalent. The total of inquiries to purchase in the same time frame nearly tripled to four million pounds U_3O_8.

Inventory holders continue to comprise over half of the sellers with available near term material. However, utilities have responded to the current low price of material and make up 60 percent of the purchasers actively seeking material in the near term. A continuation of this trend could have a strengthening effect on the market.

Four uranium transactions are reported this month. Three of the transactions involve a total of about three-quarters of a million pounds U_3O_8 for delivery in 1981 and 1982. The fourth transaction is a long term contract for between three and six million pounds U_3O_8. Deliveries are spread out over a ten year period beginning in 1984. The **Transaction Value** decreased slightly to $24.30 per pound U_3O_8. This month's calculation includes ten transactions over the past five months. The **Loan Use Charge Rate** remained at last month's level of 5½ percent.

The near term market for secondary conversion services remains thin with limited buyer interest. The **Conversion Value** dropped to $1.10 per pound U from last month's level of $1.15 per pound U. Inventory sellers must offer attractive prices to "deconvert" UF_6 to U_3O_8 in order to move their material. There are no secondary market conversion transactions reported this month.

All uranium extracted from Saskatchewan Crown lands in Canada is subject to that province's royalty tax. The royalty system has two components, a basic royalty and a graduated royalty. A detailed look at the method of calculation and payment of the royalties is covered in this Report.

The *Essay* updates the list of signatories of the Treaty on the Non-Proliferation of Nuclear Weapons and reviews the International Atomic Energy Agency safeguards agreements and the participating nations.

The last installment of the three-part *Topical Essay* on unconventional transactions looks at the barter as a strategic tool.

The *Raw Materials* essay continues last month's report on Spain's nuclear program with an emphasis on the geological makeup of the country.

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OCTOBER 1981 NUMBER 158

Monthly Report on the Uranium Market

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NUEXCO

MONTHLY REPORT ON THE URANIUM MARKET

October 1981 No. 158

JAMES E. VAUGHAN, *EDITOR* TERESA T. ELMS, *ASSOCIATE EDITOR*

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FOREWORD

We would like to take this opportunity to recognize the people behind the scenes at Nuexco, the Administrative Staff, for their tremendous contribution in all aspects of the organization. Seated from left to right: Marian Cruz, Linda Vogl, Doris Willbanks, Betty Bryant. Standing from left to right: Wendy Boyden, Kathie Kuziel, Dolores T. Fazzino, Alan Gemanis, Christie Maggard.

Enclosed with this Report is a copy of two speeches, one by Tom Boyden, one by Jerry Reaves, presented at the Society of Mining Engineers, 5th Annual Uranium Seminar on September 20-23, 1981 in Albuquerque, New Mexico.

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URANIUM MARKET

GENERAL

Forecast of Uranium Production

This Report presents Nuexco's latest forecast of uranium production for the world outside Communist areas (WOCA). Those forecasts are quantified in Tables 1, 2 and 3. Table 1 summarizes Nuexco's forecast of US production of U_3O_8 for centers operating or under construction as of September 30, 1981. Table 1 also shows Nuexco's estimate of U_3O_8 produced in 1981 by plants which have been shut down this year. Table 2 shows Nuexco's forecast of world U_3O_8 production by region; Table 3 contains the same production estimates segmented according to status of the production center.

Production centers are divided into categories, according to stage of development, as follows:

1. Operating production centers — those which have shipped U_3O_8 in commercial quantities on or before September 30, 1981.

2. Production centers under construction — those which were being built as of September 30, 1981, and which have an established access to ore reserves. Conventional production centers are included in this category only if mill construction has actually begun.

Each category is further divided, according to source, as follows:

- Conventional milling
- Unconventional recovery methods:
  - Solution mining, including *in situ* leaching and hydraulic mining
  - Phosphoric acid by-product recovery
  - Heap leaching, including leachings of tailings and copper dumps.

Annual US production is expected to decline from the 1980 peak of 42.5 million pounds U_3O_8 to about 37 million pounds U_3O_8 in 1981, approximately the same as 1979. That conclusion is consistent with those of DOE and other analysts. However, Nuexco expects US production to decline to less than half the 1980 level, 20 million pounds U_3O_8, by 1984 and to stabilize at 14-16 million pounds per year in the second half of this decade. The decrease is due to declining ore grades, depletion of orebodies and production cutbacks due to high costs and low prices.

While the forecast of uranium production presented in Nuexco Report 147 underestimated the time required for US producers to respond to declining market prices, the forecast presented in this Report has taken into account that inertia. As a result, the production estimate for 1981 exceeds that of Report 147 by eight million pounds U_3O_8.

Nuexco's forecast of WOCA uranium production shows the total annual production for 1981 at 111 million pounds U_3O_8, and 1982 at about 110 million, essentially the same as 1980. For the rest of the decade, total annual production is forecast to decline slightly, remaining in the range of 104 to 108 million pounds U_3O_8 for 1983-1990. As US production declines, other production will increase, so that the US portion of the total declines steadily from 38 percent in 1980 to 17 percent in 1985. For the balance of the decade, the US

Table 1

US URANIUM PRODUCTION FORECAST
(Millions of Pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Operating										
Conventional Mills	28.7	19.6	15.9	14.1	12.7	9.7	9.7	9.3	9.3	8.8
Unconventional Sources	7.2	7.7	6.8	5.5	5.1	5.1	5.1	5.1	5.1	4.3
Subtotal	35.9	27.3	22.7	19.6	17.8	14.8	14.8	14.4	14.4	13.1
Under Construction (as of 9/30/81)	0.3	0.6	0.7	0.7	0.7	0.7	0.5	0.5	0.5	0.5
Shutdown or Cancelled (as of 9/30/81)	1.0	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
TOTAL (rounded)	37	28	23	20	19	16	15	15	15	14

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URANIUM MARKET

Table 2

WORLD URANIUM PRODUCTION FORECAST[1]

(Millions of Pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Australia	7.1	12.1	12.1	11.2	9.4	8.4	8.4	8.4	8.4	8.4
Canada	20.0	21.0	19.7	23.6	26.7	26.7	28.2	32.2	32.2	32.2
Niger, Gabon	13.9	13.9	13.9	13.9	13.9	13.9	13.9	13.9	13.9	13.9
France	5.5	6.7	7.1	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Namibia	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Republic of South Africa	15.9	16.6	17.7	18.4	18.4	18.1	17.9	17.8	17.8	17.7
Other Nations[2]	1.4	1.6	2.7	2.9	3.4	3.4	3.4	3.4	3.4	3.4
Non-US Total	73.8	81.9	83.2	87.6	89.4	88.1	89.4	93.3	93.3	93.3
US[3]	37.2	27.9	23.5	20.4	18.5	15.6	15.4	14.9	14.9	13.6
TOTAL (rounded)	111	110	107	108	108	104	105	108	108	107

[1] Outside Communist Areas

[2] Argentina, Belgium, Brazil, Chile, Portugal, Spain and others

[3] This Report, Table 1

fraction declines very slowly to only 13 percent in 1990.

The reasons behind Nuexco's forecast of declining US production have been detailed in previous Reports. However, the reasons for other producers' ability to expand production at the same time bear repeating. The reasons include:

1. The continuing decline in spot market prices has affected uranium producers in the rest of the world more slowly and to a lesser extent than in the US.
2. These effects have so far been limited to a few commercial producers of uranium, as opposed to captive producers.
3. Some older non-US production facilities can be expected to phase out due to the same pressures of high cost and low grade which affect US producers, but the resulting decreases in production will be more than offset by new production from high-grade reserves in Canada and Australia.
4. Production arising from facilities captive to aggressive national nuclear power programs will also help to offset the forecast decline in US production. Active promotion of nuclear power by the governments of several nations allows them to use longer planning horizons than their US counterparts. Additionally, much of the important production outside the US is dedicated to attaining and sustaining national self-sufficiency in the nuclear fuel cycle, or at least in nuclear raw materials. For these reasons, much of what might otherwise be excess or economically marginal uranium production outside the US will continue in operation.

The forecast of world production presented herein necessarily reflects some subjective opinions about commercial decisions which will be faced over the next few years by uranium producers. The decisions include whether to:

1. Continue funding some projects already under construction;
2. Expand exploration programs, terminate them or to continue them at some intermediate level;
3. Postpone or terminate planned expansions;
4. Continue uneconomic or marginal mining and milling operations in the hope of near term improvement in the spot market price;
5. High-grade where possible, in effect sacrificing mine life for short-term improvements in average cost of production;
6. Divest themselves of less attractive mining or milling operations;
7. Withdraw altogether from uranium mining and milling.

Those decisions will be based on many factors, but the ultimate outcome of production decisions will most probably be determined by the economics of free

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Table 3

WORLD URANIUM PRODUCTION FORECAST[1]
(Millions of Pounds U_3O_8)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Operating										
US	36.9	27.3	22.7	19.6	17.8	14.8	14.8	14.4	14.4	13.1
Non-US	73.7	73.1	72.8	71.8	67.3	65.0	66.2	66.2	66.1	66.3
Subtotal	110.6	100.4	95.5	91.4	85.1	79.8	81.0	80.6	80.5	79.4
Under Construction										
US	0.3	0.6	0.7	0.7	0.7	0.7	0.5	0.5	0.5	0.5
Non-US	0.1	8.8	10.4	12.1	13.6	13.6	13.6	13.6	13.6	13.6
Subtotal	0.4	9.4	11.1	12.8	14.3	14.3	14.1	14.1	14.1	14.1
Planned										
US	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Non-US	-0-	-0-	-0-	3.6	8.4	9.6	9.6	13.6	13.6	13.6
TOTAL (rounded)	111	110	107	108	108	104	105	108	108	107

[1] Outside Communist Areas

market competition except for certain producers captive to electric utilities or national nuclear power programs.

The Sixth Annual Symposium of the Uranium Institute took place in London last month. Over 350 participants representing 26 countries attended the sessions. In the past, the Institute has been viewed as primarily a non-US group, but with the resolution of the legal problems in the uranium industry, there is a growing exchange of ideas and involvement by US organizations.

In a major policy address at the Institute Symposium the US Assistant Secretary of State outlined changes in the US government position concerning the export of enriched uranium and nuclear equipment. Under the new policy, the US Department of Energy (DOE) will abolish case-by-case approvals for the transfer of spent fuel and reverse US policy established under the Carter Administration to stop civil reprocessing and breeder reactor development abroad. The new policy will encourage reprocessing and the breeder reactor in countries with advanced nuclear power programs where it does "not constitute a proliferation risk." On uranium matters, the Assistant Secretary confirmed that DOE does not see the need to alter the current phasing out of uranium import restrictions.

AUSTRALIA

Australia has signed a nuclear safeguards agreement with the European Atomic Energy Community (Euratom) designed to ensure that exports of Australian uranium to Euratom member states will be carried out in accordance with Australia's nuclear safeguards policy. The agreement will come into force following the exchange of diplomatic notes. Although the accord does not cover transfers of nuclear material from Euratom members to Australia, member states which do not have bilateral agreements with Australia have agreed in side-letters that they are prepared to enter into discussions about supplementary agreements if and when appropriate.

The Uranium Enrichment Group of Australia (UEGA) is pressing ahead with its feasibility study for an Australian enrichment plant. Its next report, expected some time next year, will be making recommendations on the preferred technology. Should it be decided to pursue the recommendations, questions of location and protective measures as well as the environmental and social impact of the proposed

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plant will come under closer examination.

It was announced this month that the Australian government had approved a long term sale by Queensland Mines Ltd. to Electricité de France. The contract price is market related, subject to the Australian floor price guidelines. The transaction involved 5.2 million pounds U_3O_8 for delivery between 1982 and 1988.

CANADA

Western Canada appears to be a beneficiary of the uranium price drop which has taken place over the last 20 months. In recent months, Saskatchewan producers have either signed or are very close to completing several long term sales agreements. The bulk of these are with US buyers.

As a result of low spot prices and the near term bleak price outlook, very few US producers are offering material. Australian and South African producers are participating in the market to some degree, but the Canadians have had the most success. US buyers have, on numerous occasions, voiced strong preferences for North American yellowcake. Some of these agreements extend ten years or more and the contractual terms are such that the sellers will profit by market improvements. These are not distress sales nor distress purchases. These contracts were negotiated in a clear buyer's market.

Since additional US buyers in particular are expected to be interested in concluding long term purchase agreements over the next few months, the selling pace of Canadian producers may well continue throughout 1982.

EUROPE

In France, the public debate on nuclear power promised by President Mitterrand upon his election will take place in Parliament in early October. Most observers do not expect a radical change in France's nuclear power program, but only a slowdown of plant orders for the second half of the decade. This debate will be followed anxiously by the world's nuclear industry, since France has been the leading example of a nation's commitment to, and successful implementation of, nuclear power policies.

At present, the intention of the Mitterrand government is that all nuclear plants currently under construction will go ahead. Thus there will be no cutback in installed capacity through about 1986. Of the plants which are planned, but not yet under construction, the government plans to cut back by about one third. In the 1982-1983 time period, the previous government had planned to order eight 1300 MWe units and one 900 MWe unit. The sites for the 1300 MWe units were Cattenon (two units), Chooz (two units), Golfech (two units), Penly (one unit) and Nogent sur Siene (one unit). The 900 MWe unit was to be at Chinon. Thus three of the eight 1300 MWe will probably not be ordered in the 1982-83 time frame if the government's intentions are carried out. The government's program must be approved by the French National Assembly, and it is likely that the cutbacks will be accepted due to a recent downward revision in forecast electricity demand in France.

FAR EAST

In previous Reports Nuexco has reviewed and commented upon Japan's nuclear power program and the resultant demand for uranium as follows:

1. Japan's official government forecast calls for 51,000-53,000 MWe of nuclear generation by 1990 and 74,000-78,000 MWe by 1995.
2. If such levels were attained, Japan's utilities would need additional uranium supplies beginning in 1990, and could be expected to begin procurement activity well before that date.
3. Nuexco believes that the government planning is overly optimistic and believes that placing 40,000 MWe nuclear into operation by 1990 would be a commendable performance.

The foundation of Nuexco's opinion is outlined in Table 4 which depicts, on a year by year basis, actual utility planning, based on the realities of site procurement, environmental and safety evaluation and plant construction schedules. It should be noted that, even now, several plants included on this list for operation in the late 1980's still lack site definition and are categorized as "new" sites. The total utility planned 27 units and 25,240 MWe, when added to existing capacity of 23 units and 15,700 MWe, produces grand totals of 50 units and 40,640 MWe.

It will be recalled that the Japan-Australia Uranium Resource Development Company (JAURD) holds an equity interest in Energy Resources of Australia (ERA)

Table 4

JAPAN UTILITY PLANS FOR ADDITIONAL NUCLEAR GENERATION
1981 - 1990
(Capacity in MWe)

Year	PLANT NAME MWe Capacity — Utility (See Note)							Total MWe by Year
Prior to 1981	22 reactors 15,141							15,141
1981	Genkai-2 559-KYU							559
1982	Ikata-2 556-SHIK	Fukushima 2-1 1100-TEPCO						1666
1983								0
1984	Fukushima 2-2 1100-TEPCO	Onagawa 524-TOH	Kawauchi-1 890-KYU					2514
1985	Takahama-3 826-KEPCO	Fukushima 2-3 1100-TEPCO	Takahama-4 826-KEPCO					2752
1986	Fukushima 2-4 1100-TEPCO	Hamaoka-3 1100-CHUBU	Tsuruga-2 1160-JAPC	Kawauchi-2 890-KYU	Kashiwazaki-1 1100-TEPCO			5350
1987								0
1988	*"New"* Site 1200-KEPCO							1200
1989	Ikata-3 890-SHIK	Kashiwazaki-2 1100-TEPCO	*"New"* Site 1200-KEPCO	Maki 825-TOH	Shimane-2 820-CHU	Kyowatomari-1 579-HOKK		5414
1990	Kyowatomari-2 579-HOKK	Noto 540-HO	*"New"* Site 1100-TEPCO	Shimokita-1 1100-TEPCO TOH	*"New"* Site 1100-CHUBU	Kashiwazaki-5 1100-TEPCO	Namie-Odaka 825-TOH	6344
TOTAL								25,240

Note: Utility Abbreviations: TEPCO (Tokyo Electric), KEPCO (Kansai Electric), CHUBU (Chubu Electric), SHIK (Shikoku Electric) CHU (Chugoku Electric), KYU (Kyushu Electric), TOH (Tohoku Electric), HOKK (Hokkaido Electric), HO (Hokuriku Electric), JAPC (Japan Atomic Power).

(the Ranger project). The participants in JAURD are

Kansai Electric Power Co.	50%
Kyushu Electric Power Co.	25%
Shihoku Electric Power Co.	15%
C. Itoh	10%

JAURD will receive about two million pounds U_3O_8 annually from ERA beginning in 1982, and it is anticipated that each utility company will take its pro-rata share. C. Itoh must, of course, sell its portion, and it is presently thought that such share will be taken up by Kansai.

UNITED STATES

On September 25 the US Senate Subcommittee on Energy Research and Development under the Committee on Energy and Natural Resources held a preliminary hearing. The purpose of the hearing was to

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examine the viability of the domestic uranium mining and milling industry. Senator Pete V. Domenici of New Mexico as Chairman of the Subcommittee heard testimony from participants including representatives from the US Department of Energy (DOE), Energy Information Agency (EIA), Department of State, and several US uranium firms.

Under Section 161v of the Atomic Energy Act of 1954, DOE is charged with "assuring the maintenance of a viable domestic industry." One method available to do this is by restricting the amount of foreign uranium enriched in the US for domestic use. Such restrictions were placed in 1964. In 1974, the Atomic Energy Commission decided to gradually remove the limitations. Currently, the limitation is 40 percent non-US, scheduled to increase to 60 percent in 1982 and 100 percent in 1984.

Senator Domenici had previously requested two studies on the viability of the US uranium industry. The studies were *The Domestic Uranium Industry and Imports of Uranium* (February 23, 1981) by DOE and *The Impact of Various Federal Uranium Policies on the Uranium Market* (September 1981) by EIA. Both studies were referred to during the hearing.

Testimony was given by the following:

1. *DOE*. The DOE spokesman outlined the conclusion of the February 1981 Report requested by Senator Domenici. The DOE study concluded that "there does not appear to be any current need for any changes to the (restriction removal) plan." However, other speakers from the uranium industry commented that the DOE Report was out of date due to the major cutbacks and shutdowns in the uranium industry which have taken place in 1981.

2. *EIA*. The Administrator of the EIA in his testimony analyzed several US government policy options which would affect both the domestic and foreign uranium market. He concluded that "the dominance of natural market forces in the near term would be hard to overcome through any of these policy changes." The options which incorporated some type of import control were viewed as having the largest potential impact on prices and the industry as a whole in the longer term.

3. *State Department*. The State Department spokesman stressed free trade and the maintenance of a trusting reputation vis-a-vis important US trading partners such as Australia and Canada, also strong supporters of nuclear nonproliferation. He echoed the DOE statement that the lifting of the import restrictions was working well and that a revitalization of the nuclear power industry was the move needed to aid the uranium industry.

4. *Uranium producers*. The viewpoint of the uranium producers differed significantly from the government spokesman. While recognizing that the near term domestic industry problem does not stem from foreign imports, the threat of large quantities of foreign uranium in the long term translates into a US industry with little chance of recovery. They emphasized the need for strong industry support today in order to encourage decisions to continue production. An immediate 20 percent limitation on foreign uranium for enrichment for domestic use was advocated by spokesmen from major US producers.

Due to the budget discussions and voting taking place concurrently on the Senate floor, Senator Domenici was the only Subcommittee member present. Senators East (R-NC), Nichols (R-OK), Weicker (R-CT), Warner (R-VA), Ford (D-KY), Burnet Johnston (D-LA), Bumpers (D-AR), and Tsongas (D-MA) are the other subcommittee members, none of whom attended the hearing. However, Senators Wallop (R-WY) and Simpson (R-WY) were present for part of the hearing. Last year, Senator Domenici succeeded in convincing the Senate to add a rider to the fiscal 1981 energy appropriation bill limiting the enrichment of foreign uranium for domestic use in new enrichment contracts. However, the amendments to the Senate version of the bill were dropped in conference. Senator Domenici has not introduced similar legislation this year, but this hearing could help him build a case.

On a subject related to the Subcommittee hearings, US Secretary of the Interior James Watt addressed a gathering in Denver, Colorado at the 1981 American Mining Congress on September 28. Watt indicated he felt it his responsibility to assist in the orderly development of US natural resources. Watt pledged his efforts toward reducing the level of federal interference that now exists in the mining industry. Regarding the minerals contained on federally-owned land, Watt confessed that "we just don't know enough" about what the US potential may be and promised to push toward the more definitive answer to US strategic mineral needs and resources.

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URANIUM MARKET

PRICING

The **Exchange Value** as of September 30, 1981 is $23.50 per pound U_3O_8, unchanged from the two previous months. The most important factors considered in this month's Exchange Value were:

1. The majority of sellers which previously were willing to put downward pressure on the market by competing for the limited sales opportunities have either sold their material or have withdrawn from the market.
2. Although the market appears to be stronger relative to last month, the meeting level for buyers and sellers continues to be close to current Exchange Value.
3. Responses to a firm bid to buy have not indicated a willingness on the part of sellers to go below the level of current Exchange Value.

The near term supply/demand ratio continues to be less than two to one. Prior to this month the ratio has averaged about nine to one during 1981. Utilities are becoming more active as purchasers especially in the long term. While these factors reiterate the strengthening of the demand sector observed last month, the continued presence of large inventories and the general worldwide oversupply situation cautions against an overly optimistic view.

Material now available for sale with delivery in the near term, as listed in the *Market Opportunities* of this Report, totals 7.4 million pounds U_3O_8. Primary producers and holders of inventory each are offering about 50 percent of this material. Active inquiries to purchase in the same time frame amount to 4.1 million pounds U_3O_8. The amount of material sought by utilities represents approximately forty percent of the total demand.

The **Transaction Value** decreased to $23.90 per pound U_3O_8. This month's calculation included eleven transactions over the past four months. The first delivery of the long term contract between an Australian producer and a European buyer reported in the *Australian* section of this Report was not included in the Transaction Value sample. This transaction is priced at market price in effect at the time of delivery, subject to the Australian floor price. Even though the floor price will probably govern during the first year of delivery, the transaction was still omitted because only transactions which have an objectively determinable price are included in the Transaction Value sample. The **Loan Use Charge Rate** remained at 5½ percent.

CONVERSION

The **Conversion Value** remained at $1.10 per pound U for the second consecutive month. One secondary market conversion transaction is reported this month at a price a little below current Conversion Value.

As indicated in the *Market Opportunities* section of this report, there are no active inquiries to purchase secondary market conversion services in the near term. Sellers continue to offer secondary market conversion services at about the level of Conversion Value. The absence of buyers has led to stability in the level of offers since there is no immediate driving force to cut prices. There is some demand in late 1982 and beyond for secondary market conversion services from utilities that are without primary converter contracts and in need of conversion services at that time. However, these buyers currently do not have concentrates available to swap for UF_6; thus the deconversion swap is not possible at this time.

The total of secondary market conversion services available for sale in the near term is two million pounds U. Most sellers are holders of UF_6 inventory wishing to respond to U_3O_8 inquiries to purchase.

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TOPICAL ESSAY

THE BRIDGE TRANSACTION

The uranium market is in the somewhat curious position of having suffered a price drop of almost 50 percent in real terms in a general economic period when the major inflation indicators are rising at about ten percent and the prime rate is around 20 percent. The collective effect of these factors has been disastrous for many sellers of uranium. However, there is at least one way in which sellers can take advantage of the high interest rates. The term "bridge transaction" has been coined to describe this method, and it capitalizes upon the fact that different market participants assess the time value of money in different ways.

The basic concept is that by inserting an intermediary party and delaying the payment to the seller, the buyer can record a purchase price below market value while the seller can record a sale price above market value.

A bridge transaction might take place as follows: In the course of a negotiation an impasse is reached because the seller wishes to sell at a high price while the buyer wishes to purchase at a low price. A bridge transaction can circumvent this problem in some instances. Basically, an intermediary firm steps in to the transaction, and from an appearance standpoint, a three party transaction is created in which there are two different uranium prices.

Figure 1 demonstrates this concept visually. In Step 1, the Seller delivers the material to the Intermediary. The Intermediary immediately delivers the material to the Buyer. The Buyer pays the Intermediary upon delivery (or on any other prearranged payment schedule). Rather than immediately transferring the funds to the Seller, the Intermediary instead puts the funds in an investment vehicle. An escrow type arrangement may be put in place to satisfy any security concerns that the Seller may have.

After the funds in the investment vehicle have grown enough to give the Seller an acceptable price per pound, the funds are then transferred from the investment vehicle to the Intermediary firm and immediately to the Seller.

Example: On October 1, 1981 a Seller delivers 100,000 pounds U_3O_8 by book transfer to an Intermediary firm, which in turn delivers the material immediately to a Buyer. Also on October 1, the Buyer pays the Intermediary firm $2,300,000, which corresponds to a price of $23.00 per pound U_3O_8. The Intermediary firm invests the funds in an investment vehicle, which might be a combination of certificates of deposit, Treasury bills, and commercial paper, for a period of four months. The return on this investment is 16 percent.

Four months later, on February 1, 1982, the principal plus interest has grown to approximately $2,417,000, which corresponds to a price of $24.17 per pound U_3O_8. This sum is transferred from the investment vehicle to the Intermediary company, and immediately passed on to the Seller. Thus the Buyer records a purchase price which is less than the spot market price at the time of delivery, while the Seller records a price that is greater than the market price at the time of delivery.

The key element in this transaction is the Seller's perception of the time value of money compared to its need for a particular price. For some firms, receiving $23.00 per pound U_3O_8 today is exactly the same as receiving $24.17 four months from now. For these firms, a bridge transaction will have little application. However, there are firms and situations where there is a difference between these two price/payment schedules. Specifically:

A. Utilities which have purchased uranium at a particular price above the current market and now desire to sell. It may be difficult to receive management or Public Utility Commission approvals for a sale at a price less than the original purchase price.

B. Producers or utilities that wish to receive a price greater than market price in a stagnant or falling market. Some firms may not wish to be thought of as contributing to a depressed market. Also, it may be necessary for these firms to record a sale price equal to or greater than market price in order to receive management approval for the sale.

The bridge transaction is one more tool available to a uranium marketer. Although the seller application is more limited, almost any buyer may be able to take advantage of it.

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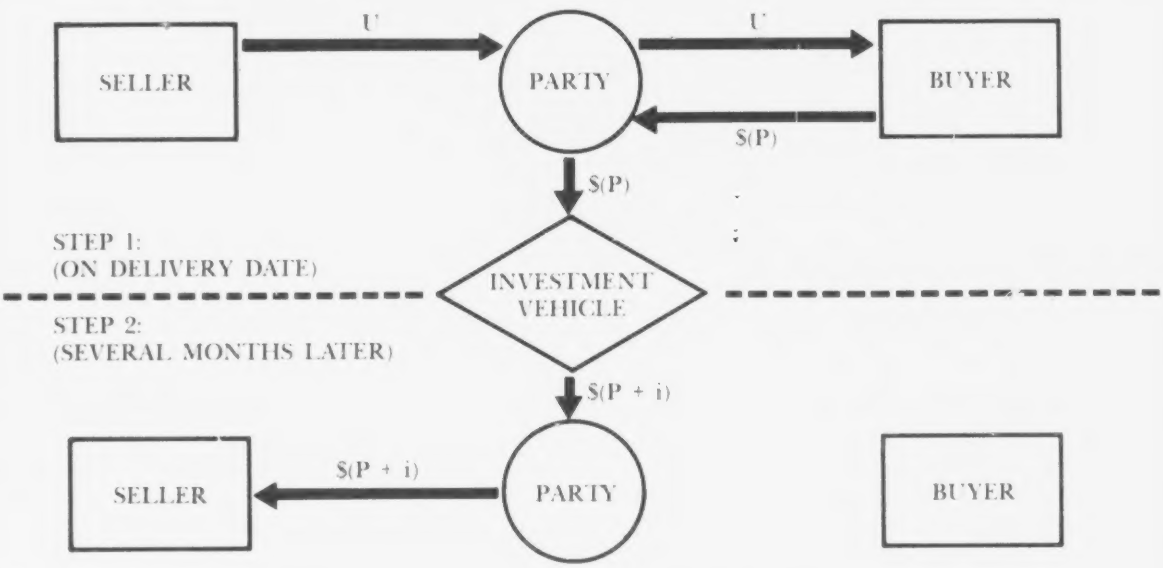
TOPICAL ESSAY


SELLER
U
PARTY
U
BUYER
$(P)
$(P)
STEP 1:
(ON DELIVERY DATE)
INVESTMENT VEHICLE
STEP 2:
(SEVERAL MONTHS LATER)
$(P + i)
SELLER
$(P + i)
PARTY
BUYER

	PRICE	PAYMENT DATE
SELLERS VIEW:	ABOVE MARKET PRICE	SEVERAL MONTHS AFTER DELIVERY DATE
BUYERS VIEW:	BELOW MARKET PRICE	ON DELIVERY DATE

P = PRINCIPAL
i = INTEREST

Figure 1

MOVEMENT OF URANIUM AND MONEY IN A BRIDGE TRANSACTION

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KEY LAKE PROJECT — PART I

On August 27, 1981, the Key Lake project was given the official green light to proceed with a mine and mill development program. The Key Lake Mining Corporation (KLMC) successfully negotiated the surface lease with the Department of Northern Saskatchewan (DNS) which allows KLMC access to and mining of the Key Lake deposits. The surface lease covers an area of approximately 25 square kilometers. As shown in Figure 2, Key Lake is situated near the contact of the Athabasca sandstone and the Wollaston Formation, along the southeastern portion of the Athabasca sedimentary/structural basin. More precisely the project area is located at latitude 57° 12' north and longitude 105° 39' west.

The surface lease was the last condition of approval required before KLMC could initiate full scale development of the project. The purpose of the lease is to serve as an instrument of conveyance whereby KLMC assumes full obligation to operate within the project area under terms and conditions established by the Key Lake Board of Inquiry and DNS. Primarily it requires KLMC to operate the mining and milling project according to pre-determined consideration for environmental and regulatory requirements of Canadian and Saskatchewan law.

In addition to the above requirements, the surface lease specifies employment and contracting practices to be followed by KLMC. Permanent residents of northern Saskatchewan must make up 50 percent of the unskilled work force during the first year of construction, increasing to 60 percent of the construction and operating force thereafter. The skilled labor force will total 15 percent native personnel. Supervisory and administrative personnel must include ten percent residents of northern Saskatchewan. In order to integrate the natives throughout various levels of the work force, KLMC will initiate an on site apprentice training program for unskilled workers.

Contractors and support businesses already located in northern Saskatchewan will be granted job priority if their bid cost is not more than ten percent above bids by competitors from the southern districts of Saskatchewan. KLMC is required to make public an annual business plan which includes the type and content of contracts to be generated during any 12-month period. The purpose is to allow prospective bidders time to prepare their submittals.

Each of the above requirements will most likely add to project costs, especially during the construction period. However, the effect on overall production costs is expected to be minimized, thus eliminating any potential marketing disadvantage for KLMC.

Other priority requirements involve complete health and safety programs for all personnel including minimization of individual exposure time to radiation; monitoring and control of the socio-economic impact on the northern communities; and continued protection of the natural environment through the practical application of standards already established at other mines in the district.

The approved requirements of the surface lease closely parallel the recommendations of the five-member Key Lake Board of Inquiry as set forth in its January 1981 conclusion of the KLMC development plan. Project environmental and development plans were submitted to the Board of Inquiry in January 1980 after several years of preparation by KLMC. The Board, appointed by the Government of Saskatchewan, completed its study in December 1980 and the recommendation for acceptance by the government followed in January.

History of Exploration

During the 1970-71 period, anomalous radioactivity was discovered in the vicinity of Zimmer Lake during an airborne survey conducted by a joint venture. The venture participants were Bel Oil Corporation, Inexco Mining Company, both of the US, and Uranerz Exploration and Mining Limited (UEM), a firm associated with Uranerzbergbau GmbH of Bonn, Federal Republic of Germany. Follow-up evaluation on the ground resulted in the discovery of high-grade uranium and nickel-bearing boulders in glacial debris.

The exploration effort was immediately intensified to include detailed geochemical and geophysical surveys in an attempt to locate more mineralized boulders. Geologic mapping began in 1971 as a way to trace the boulders to the source area. More boulders were located on the north shore of Zimmer Lake in 1972. During the winter of 1972-73 test drilling was initiated in the area of the second boulder find. No traces of uranium were found in the eighteen holes drilled.

Exploration continued in a northeasterly direction to Seahorse Lake where more mineralized boulders were found on the north shore by detailed radiometric prospecting during the summer of 1973. Drilling was commenced once again during the winter of 1974-75. It

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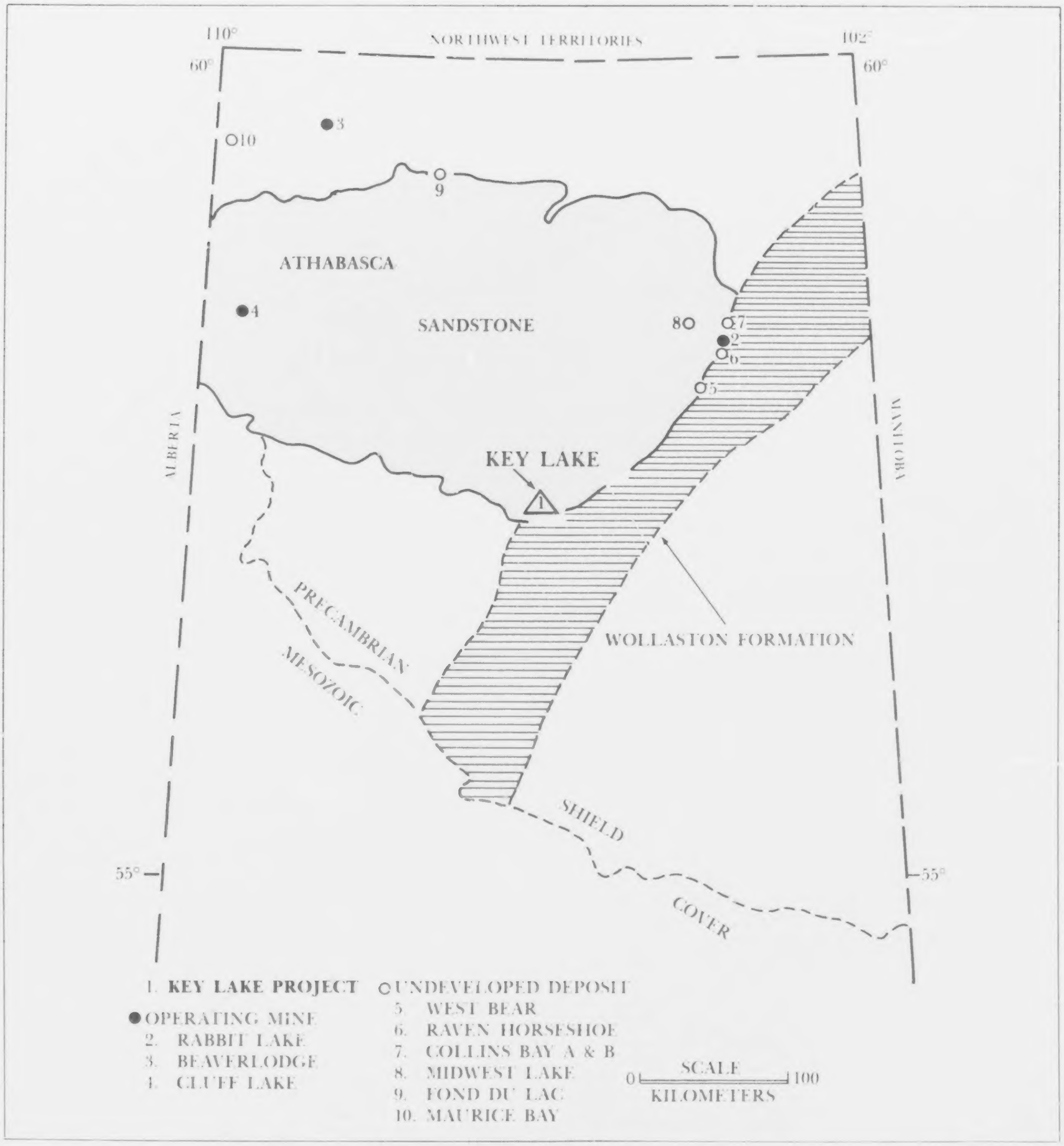
110°
NORTHWEST TERRITORIES
102°
60°
60°
10
3
9
ATHABASCA
SANDSTONE
4
8
7
2
6
5
ALBERTA
MANITOBA
KEY LAKE
1
WOLLASTON FORMATION
PRECAMBRIAN
MESOZOIC
SHIELD
COVER
55°
55°
1. KEY LAKE PROJECT
● OPERATING MINE
2. RABBIT LAKE
3. BEAVERLODGE
4. CLUFF LAKE
○ UNDEVELOPED DEPOSIT
5. WEST BEAR
6. RAVEN HORSESHOE
7. COLLINS BAY A & B
8. MIDWEST LAKE
9. FOND DU LAC
10. MAURICE BAY
SCALE
0
100
KILOMETERS

Figure 2

LOCATION OF THE KEY LAKE PROJECT WITH RELATION TO OTHER URANIUM DEPOSITS IN THE DISTRICT, NORTHERN SASKATCHEWAN

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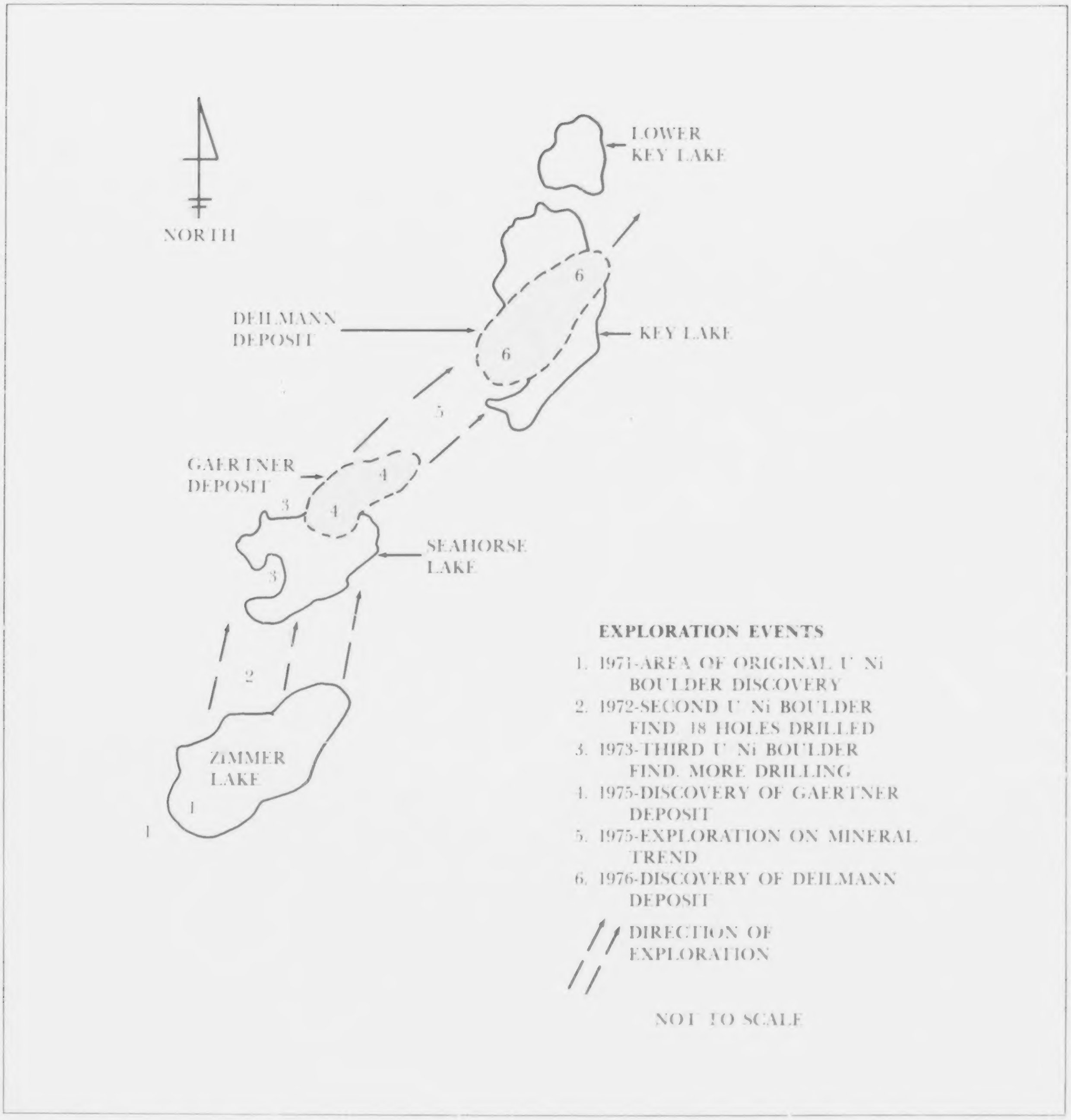
NORTH
LOWER KEY LAKE
KEY LAKE
DEILMANN DEPOSIT
GAERTNER DEPOSIT
SEAHORSE LAKE
ZIMMER LAKE
1
1
2
3
3
4
4
5
6
6
EXPLORATION EVENTS
1. 1971-AREA OF ORIGINAL U/Ni BOULDER DISCOVERY
2. 1972-SECOND U/Ni BOULDER FIND, 18 HOLES DRILLED
3. 1973-THIRD U/Ni BOULDER FIND, MORE DRILLING
4. 1975-DISCOVERY OF GAERTNER DEPOSIT
5. 1975-EXPLORATION ON MINERAL TREND
6. 1976-DISCOVERY OF DEILMANN DEPOSIT
DIRECTION OF EXPLORATION
NOT TO SCALE

Figure 3

EXPLORATION CHRONOLOGY AND TRAVERSE SEQUENCE LEADING TO THE DISCOVERY OF THE KEY LAKE URANIUM DEPOSITS, NORTHERN SASKATCHEWAN

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was about mid-summer 1975 when ore-grade mineralization was intersected on the east shore of Seahorse Lake in the 25th test hole to be drilled. A sample taken from the core assayed over seven percent U_3O_8. The Gaertner orebody had been discovered.

Subsequent drilling outlined an orebody containing approximately 60 million pounds U_3O_8. Drilling continued along the northeast strike extension of the mineral zone and the Deilmann orebody was discovered one year later on the west shore of Key Lake less than one kilometer from the Gaertner orebody. The Deilmann deposit contains an estimated 121 million pounds U_3O_8. In addition, 11 million pounds U_3O_8 is contained in cobble ore overlying the main ore zone of the Gaertner deposit. KLMC considers approximately 155 to 170 million pounds U_3O_8 will be recovered at an average ore grade of 2.5 percent U_3O_8 during the projected 15-year life of the project. Figure 3 shows the exploration chronology and traverse sequence leading to the discovery of the Key Lake uranium deposits.

Property Ownership

The participants in the Key Lake project have changed since the early stages of exploration. Bel Oil sold its one-third interest in the joint venture to Saskatchewan Mining Development Corporation (SMDC) in 1974—before ore was discovered. SMDC is a corporation owned by the Government of Saskatchewan. It was established in 1974 to participate in the development of hard-rock mineral ventures in Saskatchewan and other provinces. Presently, SMDC participates in at lease 273 mineral ventures of which about 230 are primarily for uranium within Saskatchewan.

Inexco sold its one-third interest in the venture to SMDC in 1978. SMDC immediately sold one-half of the Inexco interest (16-2/3 percent) to Eldor Resources Limited (ERL) a wholly-owned subsidiary of Eldorado Nuclear Limited which is a Crown corporation owned by the Government of Canada. That transaction represents the last change in ownership. Equity interest in the project is now aligned as SMDC = 50 percent, UEM = 33-1/3 percent, and ERL = 16-2/3 percent. UEM was the designated operator of all exploration within the project area.

On March 1, 1979 the joint venturers formed KLMC, an operating company for the purpose of developing the ore deposits and operating all facilities. KLMC will also be responsible for continued exploration and evaluation of new ore discoveries within the surface lease area. Ownership of KLMC is in the same proportion as the joint venture interest.

STATISTICAL DATA

EXCHANGE VALUE $23.50/lb. U_3O_8
Determined as of September 30, 1981

Definition

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:
A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:
A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

TRANSACTION VALUE
Determined as of September 30, 1981

$/lb U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
23.90	2.8	11	4

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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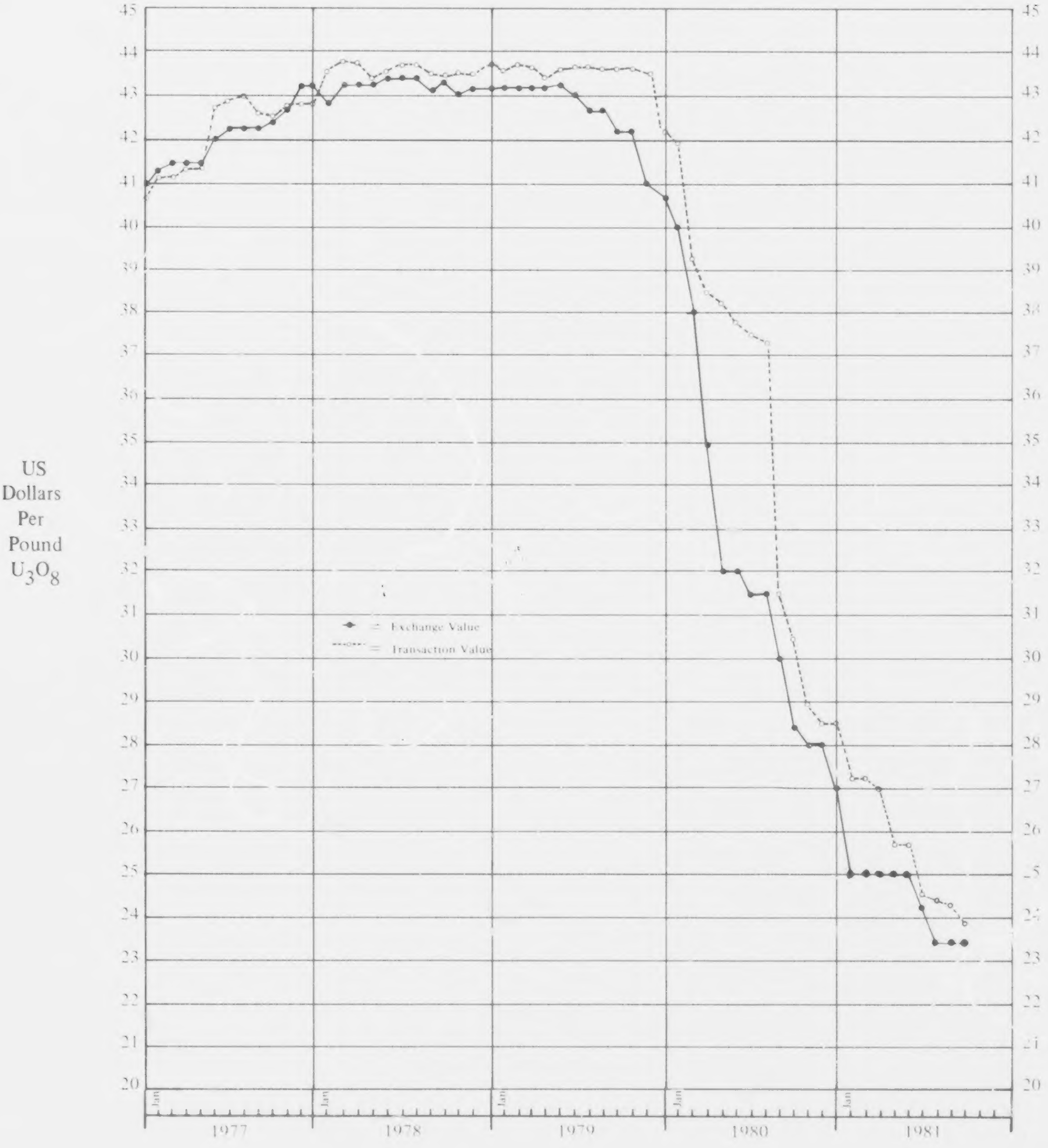
STATISTICAL DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1977

Determined as of the last day of the month indicated



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STATISTICAL DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars lb. U3O8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	–	–	–	–	–	–	–	6.35	6.35	6.40	6.45	6.50
1969	–	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50			

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars lb. U3O8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	–	–	–	–	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90			

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

Country	per lb U3O8 in Concentrates	per kg U3O8 in Concentrates	per kg U in Concentrates
US (dollar)	23.50	51.81	61.09
France (franc)	130.34	287.35	338.85
FRG (mark)	54.36	119.84	141.32
Japan (yen)	5,461	12,040	14,198
Switzerland (franc)	46.32	102.13	120.43
UK (pound)	13.10	28.88	34.06
Australia (dollar)	20.55	45.31	53.43
Canada (dollar)	28.27	62.33	73.50
Niger, Gabon (CFA)	6,517	14,367	16,943
South Africa (rand)	22.46	49.51	58.38
Sweden (kroner)	131.51	289.92	341.88

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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STATISTICAL DATA

CONVERSION VALUE $1.10/lb. U as UF_6
Determined as of September 30, 1981

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

LOAN USE CHARGE RATE 5½%
Determined as of September 30, 1981

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed as a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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STATISTICAL DATA

CURRENT TRANSACTIONS*

Uranium Transactions

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as percent of Current E.V.	Seller Group	Buyer Group	Remarks
1456	1981-86	2001-4000	–	Canada	US	Formula Price
1613	1981	Less than 50	97	US	US	
1615	1981	Less than 50	95	US	US	
1616	1982-88	4001-6000	–	Australia	Europe	Price related to market
1618	1981	101-300	98	US	US	

Conversion Transactions

Nuexco Reference Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as percent of Current C.V.	Seller Group	Buyer Group	Remarks
1619	1981	601-1000	91	US	Non-US	

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*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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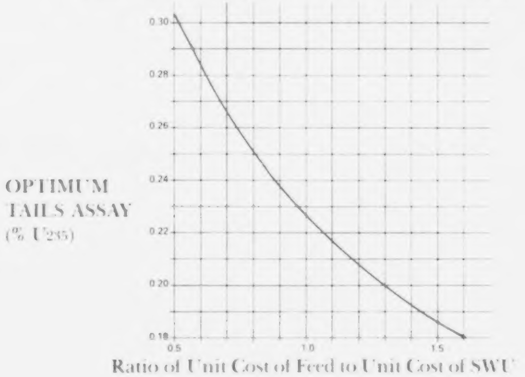
OPTIMUM TAILS ASSAY

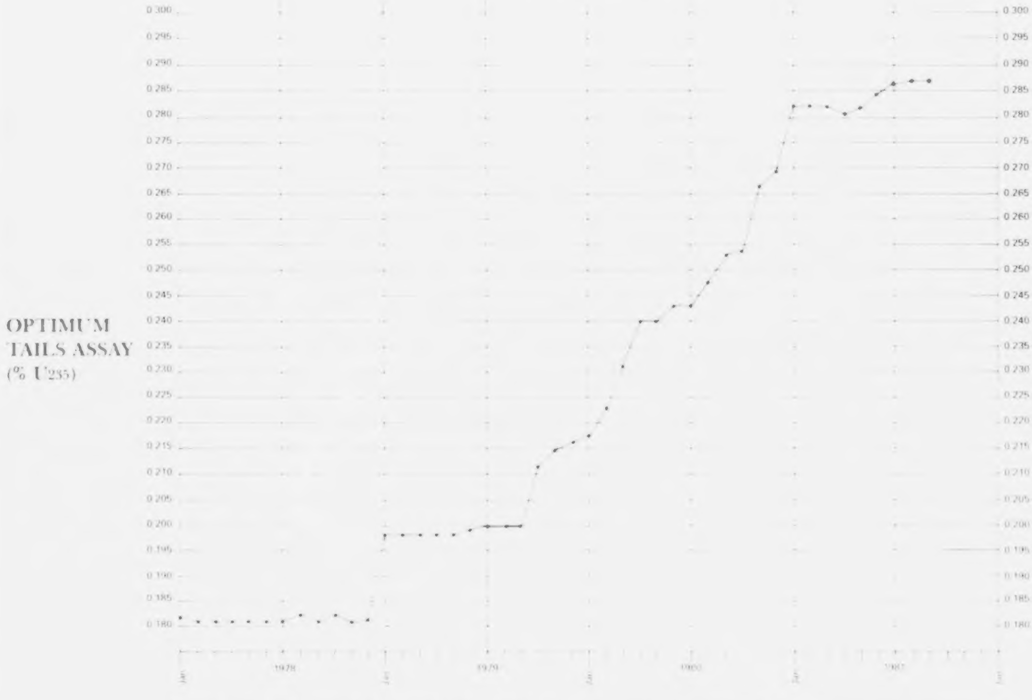
The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of UF_6 to the cost of a kilogram unit of separative work. The US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contract holders have the option, within limits, to specify the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent U_{235}. For every one-hundredth of one percent increase in the transaction tails assay, uranium consumption increases about two percent.

TAILS ASSAY FOR MINIMUM COST OF PRODUCT*



*From Nuexco Report 138

OPTIMUM TAILS ASSAY[1]



[1] Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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US GOVERNMENT STATISTICS

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Producer Price Index—All Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
					Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
Ann. Avg. 1970(5)	110.0	110.4	116.3	91.36	3.88	3.87	3.69	3.28
Ann. Avg. 1971(5)	114.1	114.0	121.3	96.02	4.12	4.15	3.97	3.49
Ann. Avg. 1972(5)	117.9	119.1	125.3	100.00	4.56	4.59	4.26	3.71
Ann. Avg. 1973(5)	125.9	134.7	133.1	105.80	4.84	4.98	4.51	3.91
Ann. Avg. 1974(5)	153.8	160.1	147.7	116.02	5.44	5.63	4.88	4.21
Ann. Avg. 1975(5)	171.5	174.9	161.2	127.15	6.13	6.24	5.39	4.64
Ann. Avg. 1976(5)	182.4	183.0	170.5	133.71	6.76	6.87	5.91	4.96
Ann. Avg. 1977(5)	195.1	194.2	181.5	141.70	7.28	7.67	6.43	5.39
Ann. Avg. 1978(5)	209.4	209.3	195.4	152.05	8.23	8.56	7.02	5.82
Ann. Avg. 1979(5)	236.5	235.6	217.4	165.46	9.27	9.50	7.60	6.32
Ann. Avg. 1980(5)	274.8	268.8	246.8	177.36	10.27	10.63	8.30	6.95
May 1980	271.9	264.2	244.9	–	10.19	10.38	8.18	6.77
Jun 1980	273.5	265.6	247.6	178.93	10.14	10.70	8.25	6.86
Jul 1980	276.2	270.4	247.8	–	10.24	10.83	8.36	6.95
Aug 1980	278.2	273.8	249.4	–	10.39	10.79	8.40	7.01
Sep 1980	278.8	274.6	251.7	182.92	10.55	10.95	8.47	7.12
Oct 1980	282.2	277.8	253.9	–	10.59	11.01	8.53	7.18
Nov 1980	283.4	279.1	256.2	-	10.73	11.07	8.60	7.27
Dec 1980	286.6	280.8	258.4	183.98	10.84	11.32	8.69	7.38
Jan 1981	291.5	284.8	260.5	–	10.91	11.31	8.74	7.41
Feb 1981	295.7	287.6	263.2	–	11.15	11.36	8.80	7.43
Mar 1981	299.6	290.3	265.1	188.14	11.13	11.50	8.84	7.47
Apr 1981	303.5R	293.4	266.8	–	11.30	11.63	8.94	7.51
May 1981	304.1	293.7	269.0	–	11.26	11.68	8.99	7.55
Jun 1981	304.7	294.5	271.3	191.17	11.31	11.88	9.07	7.60
Jul 1981	306.0P	296.0P	274.4	–	11.63P	12.13P	9.14P	7.71P
Aug 1981	307.0P	296.2P	276.5P	–	–	-	9.22P	7.88P

P = Preliminary R = Revised since last month

(1) US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

(2) US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

(3) US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

(4) US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for 1977-1978 are adjusted to the March 1979 benchmark. Data for January 1979 and beyond are adjusted to the March 1980 benchmark.

(5) Monthly data 1970-1978 for Producer Price Index-Industrial Commodities, Consumer Price Index, and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.
Monthly data 1977-1978 for Employment and Earnings SIC Codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.
Monthly data 1970-1978 for Employment and Earnings SIC Code 36 appear on page 23 of Nuexco Report 154.
Monthly data 1979-1980 for Employment and Earnings, Revised Establishment Data, all listed codes, appear in this report.
Monthly data 1977-1980 for Producer Price Index-All Commodities, appear in this report.

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STATISTICAL DATA

US GOVERNMENT STATISTICS

Producer Price Index
All Commodities (1)
(1967 = 100)

Month	1980	1979	1978	1977
Jan	254.9	220.8	200.1	188.1
Feb	260.2	224.1	202.1	190.2
Mar	261.9	226.7	230.0	206.5
Apr	262.8	230.0	232.0	208.0
May	264.2	232.0	208.0	195.2
Jun	265.6	233.5	209.6	194.5
Jul	270.4	236.9	210.7	194.8
Aug	273.8	238.3	210.6	194.6
Sep	274.6	242.0	212.4	195.3
Oct	277.8	245.6	214.9	196.3
Nov	279.1	247.2	215.7	197.1
Dec	280.8	249.7	217.5	198.2
Ann. Avg.	268.8	235.6	209.3	194.2

(1) US Bureau of Labor Statistics, Washington, D.C.: "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes").

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US GOVERNMENT STATISTICS

Metal Mining
(SIC 10)

Month	1980	1979
Jan	9.92	8.71
Feb	9.93	8.81
Mar	9.91	8.85
Apr	10.01	9.03
May	10.19	9.06
Jun	10.14	9.09
Jul	10.24	9.33
Aug	10.39	9.39
Sep	10.55	9.63
Oct	10.59	9.67
Nov	10.73	9.79
Dec	10.84	9.81
Ann. Avg.	10.27	9.27

Primary Non-ferrous Metals
(SIC 333)

Month	1980	1979
Jan	10.06	9.00
Feb	10.02	9.01
Mar	10.24	9.11
Apr	10.31	9.49
May	10.38	9.14
Jun	10.70	9.44
Jul	10.83	9.57
Aug	10.79	9.70
Sep	10.95	9.79
Oct	11.01	9.87
Nov	11.07	9.86
Dec	11.32	9.92
Ann. Avg.	10.63	9.50

Chemicals and Allied Products
(SIC 28)

Month	1980	1979
Jan	7.98	7.33
Feb	8.01	7.33
Mar	8.06	7.37
Apr	8.13	7.52
May	8.18	7.48
Jun	8.25	7.54
Jul	8.36	7.61
Aug	8.40	7.66
Sep	8.47	7.74
Oct	8.53	7.83
Nov	8.60	7.89
Dec	8.69	7.93
Ann. Avg.	8.30	7.60

Electric and Electronic Equipment
(SIC 36)

Month	1980	1979
Jan	6.66	6.12
Feb	6.70	6.14
Mar	6.76	6.17
Apr	6.78	6.12
May	6.77	6.22
Jun	6.86	6.26
Jul	6.95	6.28
Aug	7.01	6.36
Sep	7.12	6.46
Oct	7.18	6.48
Nov	7.27	6.51
Dec	7.38	6.63
Ann. Avg.	6.95	6.32

(1) US Bureau of Labor Statistics, Washington, D.C.; Supplement to Employment and Earnings Revised Establishment Data, August 1981.

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STATISTICAL DATA

AUSTRALIAN GOVERNMENT STATISTICS

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2]
Annual Avg. 1970(3)	101.4	59.88
Annual Avg. 1971(3)	101.5	65.95
Annual Avg. 1972(3)	105.6	71.26
Annual Avg. 1973(3)	124.4	78.96
Annual Avg. 1974(3)	141.9	108.07
Annual Avg. 1975(3)	150.4	132.55
Annual Avg. 1976(3)	168.4	160.93
Annual Avg. 1977(3)	192.0	179.03
Annual Avg. 1978(3)	198.5	190.04
Annual Avg. 1979	248.8	196.34
Annual Avg. 1980	321.8	217.96
May 1980	335.6	214.81
Jun 1980	338.8	214.16
Jul 1980	347.8	221.51
Aug 1980	352.0	220.08
Sep 1980	350.3	219.60
Oct 1980	348.2	221.13
Nov 1980	350.4	221.49
Dec 1980	351.7	221.81
Jan 1981	357.8	229.96
Feb 1981	356.6	229.79
Mar 1981	355.2	229.03
Apr 1981	354.6	228.75
May 1981	353.4	236.67
Jun 1981	360.4P	236.98
Jul 1981	357.5P	236.84P

P = Preliminary R = Revised since last month

(1) Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.

(2) Australian Bureau of Statistics, Canberra: "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.

(3) Monthly data for 1970 through 1978 appear on pages 1.7 and 1.8 of Nuexco Report 138.

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STATISTICAL DATA

CANADIAN GOVERNMENT STATISTICS

	Industry Selling Price Index: Manufacturing (D 500000)[1,2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[3,4]		
		Metal Mining, including milling (SIC 050-059)	Primary Metal Industries, non-ferrous (SIC 296-298)	Chemicals and Chemical Products (SIC 370-379)
Annual Avg. 1977	174.3	8.18	6.50	6.51
Annual Avg. 1978	190.4	8.76	6.82	6.97
Annual Avg. 1979	217.9	9.60	7.35	7.67
Annual Avg. 1980	247.2	10.59	8.05	8.50
May 1980	242.2	10.50	8.01	8.44
Jun 1980	243.7	10.51	8.07	8.46
Jul 1980	246.3	10.49	8.11	8.55
Aug 1980	249.4	10.58	8.14	8.65
Sep 1980	252.0	10.85	8.24	8.71
Oct 1980	256.0	11.05	8.28	8.82
Nov 1980	257.8R	11.11	8.38	8.77
Dec 1980	258.4	11.13	8.32	8.92
Jan 1981	263.3	11.27	8.51	8.90
Feb 1981	263.6	11.43	8.59	9.00
Mar 1981	265.4	11.47	8.63	9.17
Apr 1981	267.7	11.73	8.76	9.33
May 1981	269.6	11.82P	8.90P	9.49P
Jun 1981	271.9	11.67P	9.21P	9.60P
Jul 1981	273.1P	–	–	–

P = Preliminary R = Revised since last month

(1) Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

(2) Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

(3) Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

(4) Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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STATISTICAL DATA

REPUBLIC OF SOUTH AFRICA STATISTICS

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Wholesale Price Index All Groups (1975 = 100)	Total Employment in Mining and Quarrying (Code 35)[5]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[5]
Annual Avg. 1970 (3)	7.34	100.3(4)		655,346	399,164
Annual Avg. 1971 (3)	7.88	106.4(4)	59.1	652,294	415,956
Annual Avg. 1972 (3)	8.79	113.3(4)	63.9	623,067	443,933
Annual Avg. 1973 (3)	10.51	124.1(4)	72.3	684,743	572,133
Annual Avg. 1974 (3)	13.18	138.5(4)	85.3	674,140	761,596
Annual Avg. 1975 (3)	16.71	157.2(4)	100.0	639,473	1,003,617
Annual Avg. 1976 (3)	19.30	174.7(4)	115.1	671,240	1,212,983
Annual Avg. 1977 (3)(6)	23.87	194.4(4)	130.0	712,006	1,420,670
Annual Avg. 1978 (3)(6)	27.14	137.2	142.7	664,571	1,537,169
Annual Avg. 1979 (3)(6)	30.18	155.3	164.5	692,209	1,830,632
Annual Avg. 1980 (6)	35.53	176.7	192.1	714,379	2,279,615
May 1980	—	171.9	187.0	717,171	179,128
Jun 1980	34.48	174.6	189.0	714,379	183,739
Jul 1980	—	177.2	192.7	715,460	202,403
Aug 1980	—	179.2	196.8	716,486	206,514
Sep 1980	36.19	182.8	199.8	710,889	204,761
Oct 1980	—	186.3	203.1	720,246	204,602
Nov 1980	—	187.8	205.6	716,797	208,345
Dec 1980	37.69	189.9	206.5	705,087	211,829
Jan 1981	—	191.0	207.2	729,575	219,969
Feb 1981	—	193.8	209.8	725,647	210,275
Mar 1981	39.26	195.2	209.9	705,010	210,151
Apr 1981	—	196.4	211.6	719,674	217,124
May 1981	—	197.7	213.2	726,869	219,880
Jun 1981	40.41	200.0	215.3	728,506	237,049
Jul 1981	—	204.6	218.4	—	—
Aug 1981		208.0	222.6		

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(1) Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.

(2) Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."

(3) Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 19 of Nuexco Report 140.

(4) April 1970 = 100.00.

(5) Bulletin of Statistics, Department of Statistics, Pretoria.

(6) Historical data for Codes 35 and 40 1977-1980 appear on page 28 of Nuexco Report 157.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Available for Sale:				
1393			350	
1475	1100			UF_6
1480	150	300	300	
1490	1100			
1575			500	Long Term
1589	350			
1581	100	150	150	Long Term
1600			200	Long Term
1610	300	300		
1637	500	500		
1678		275		
1684	500			
1685	100			
1698	70			
1713	50			UF_6
1727	500			
1738	750			UF_6
1741	500			
1743	100	100	100	Long Term
1745	200			
1749	350			
1770	700	800		
TOTAL:	7420	2425	1600	
Available for Loan:				
1429	300			UF_6
1646	275	275	275	
1695	225	325	325	UF_6
1742	500			
TOTAL:	1300	600	600	

*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

URANIUM DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U_3O_8)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
Inquiries to Purchase:				
1459			200	Long Term
1462			100	Long Term
1603		100	100	Long Term
1634	400	400		
1699	950	300	250	
1704		200	200	Long Term
1724	600	500	500	Long Term
1732	50			
1744	1000			
1762	450			
1769	125			UF_6
1771	500			
TOTAL:	4075	1500	1350	
Inquiries to Borrow:				
1621	300			
TOTAL:	300			

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*Measured from the date of this Report.

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MARKET OPPORTUNITIES

Market Opportunities are *active* inquiries in the secondary market for UF_6 conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

CONVERSION SUPPLY

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1451	75			
1607	900			
1609	500	1500	1000	Long Term
1619		200	100	
1661		200	200	Long Term
1684	450			
1764	100			
TOTAL:	2025	1900	1300	

CONVERSION DEMAND

Nuexco Reference Number	Delivery Period* (Thousands of Pounds U as UF_6)			Remarks
	0 to 1 Year	1 to 2 Years	2 to 3 Years	
1594		400	950	Long Term
1622		400	400	Long Term
TOTAL:		800	1350	

*Measured from the date of this Report.

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EXECUTIVE SUMMARY & INDUSTRY OVERVIEW
NUEXCO REPORT 158

The **Exchange Value** remained at $23.50 per pound U_3O_8, unchanged from the previous two months. Near term supply and demand remained at about the same level as last month. About 7.5 million pounds U_3O_8 is currently being offered for sale in the near term market. Demand in the same time frame is about four million pounds. The near term supply-demand ratio of two-to-one is the strongest the market has seen in some time. Prior to this month, the 1981 average was nine-to-one. Most sellers are now reluctant to offer material significantly below Exchange Value.

The **Transaction Value** decreased slightly to $23.90 per pound U_3O_8, from $24.30 the previous month. Five transactions were concluded this month. Two were long term sales, one by a Canadian producer, the other by an Australian producer. Three near term sales are reported, all by US sellers. The prices of the near term sales are all close to Exchange Value.

The **Conversion Value** remained at $1.10 per pound U as UF_6. One near term transaction closed this month somewhat below Conversion Value. There are several near term sellers in the secondary market for conversion services, but there are no buyers at this time.

Canadian producers have been active in the US market in recent months. Several long term contracts have either already been signed or are in the final stages of negotiation with US purchasers. All Canadian contracts are subject to approval by the Canadian government review panel.

This month's Report contains a revised forecast of free world uranium production, including an estimate of 1981 world production. It appears that production in 1981 will be about the same as 1980, approximately 111 million pounds U_3O_8. US production is expected to be about 37 million pounds this year, down from 42.5 million last year. The decrease in the US will be about compensated by increases in Canada and Australia.

The *Topical Essay* this month continues the series on unconventional transactions, with the focus on Bridge Transactions. This month's *Raw Materials* essay contains the first part of a discussion on the Key Lake deposit.

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10/81

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INFLUENCE OF FOREIGN URANIUM ON THE UNITED STATES MARKET

By

T.A. Boyden
Vice President
Nuexco

"WHAT HAPPENED TO THE URANIUM BOOM?"

By

M.J. Reaves
Vice President
Nuexco

PRESENTED AT:

Society of Mining Engineers
5th Annual Uranium Seminar
Albuquerque, New Mexico
September 20-23, 1981

NUEXCO

INFLUENCE OF FOREIGN URANIUM ON THE UNITED STATES MARKET

by T.A. Boyden

The Free World uranium market is now characterized by production nearly twice that of consumption resulting in a rapid build-up of uranium inventories. Low-cost production from high-grade deposits in Australia and Western Canada will gradually add another ten to 15 million pounds U_3O_8 annually into Free World production throughout the 1980's. This latter material cannot be absorbed in further inventory build-up and can only displace higher cost production. The result is a restructuring of the Free World producer industry.

As United States production declines, US utilities must increase their reliance on foreign supplies in order to meet their needs. This paper reviews the elements that will cause the restructuring of the Free World producer industry and the expected response of the US utility industry to that developing situation.

Introduction

Ten years ago, the US had a dominant position in the uranium market, holding 25 to 30 percent of the Free World reasonably assured reserves and 35 to 40 percent of Free World production. Other major production centers were limited to Eastern Canada and Africa. US production rose continuously from 28 million pounds U_3O_8 in 1971 to 42 million pounds in 1980. Large new discoveries in Australia and Western Canada had no significant impact on the market in those years due to the long time required to develop the deposits.

Beginning in 1979, the market reacted to a series of events which had been building over several years. As of year end 1980, Free World production of more than 110 million pounds U_3O_8 was more than twice Free World consumption of 40 million pounds U_3O_8, and inventory levels were accumulating rapidly. Previous market perceptions of a uranium shortage were quickly changing to the realization of uranium over-abundance. Western Canadian production was being offered in world markets, and plans were developing quickly for bringing the Ranger deposit in Australia into production. US production peaked in 1980 and there are no signs that this production level will be attained again.

Foreign Uranium Availability

Uranium resources throughout the Free World increased four-fold from 1967 through 1979. According to Nuexco's latest estimate of reasonably assured resources at a forward cost of $25.00 or less per pound U_3O_8, approximately 86 percent of world resources available in the commercial market are located in Australia, Canada, South Africa and the United States. Of the four countries, only the US is a major producer and major consumer of U_3O_8. Thus, producers in the other three countries must export in order to market their material.

Reasonably assured resources for the four countries are tabulated according to Nuexco's latest estimate in Table 1.

Table 1

SUMMARY OF URANIUM RESOURCES REASONABLY ASSURED AT FORWARD COST BELOW $25 PER POUND U_3O_8

Country	Tons U_3O_8
Australia	457,000
Canada	297,000
South Africa	266,000
United States	349,000
Total	1,369,000

Most new production in Australia and Canada is in the form of large, high-grade deposits, most of which can be mined using low-cost open-pit methods. In South Africa, approximately 89 percent of the uranium resources occur in association with gold mineralization in the Witwatersrand quartz-pebble conglomerates. Uranium production has a low-cost allocation as a

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by-product to the production of gold. By comparison, the resources of the US are low grade, unusually deep, and are recoverable at or below $25.00 forward cost only where mine/mill facilities are now in place. Most undeveloped deposits in the US are not considered to be available at the $25.00 or less forward cost level.

Non-US Production Potential

A near doubling of production in Australia and Western Canada is forecast for the 1980's. As a consequence of production economics, high cost production in the US gradually will be curtailed. US production is expected to decrease from 37 million pounds U_3O_8 in 1981 to 14 million pounds in 1990 despite growing US consumption. Production from Australia and Canada will steadily displace US production. In this transition period, Free World production will continue to exceed consumption, resulting in increased inventory accumulation. This in turn will create additional downward pressure on uranium prices.

The above market description pits the United States and Eastern Canada against Australia and Western Canada in the Free World competition. South Africa will continue to produce at a near-constant rate with costs sufficiently low to hold a base market position. In other nations, producers are considered to be captive to their own national interests or bound by long-term contracts. For example, production from deposits in France, Niger, Gabon and Namibia is committed well into the future with existing contracts. It is doubtful whether much of this material will soon become available for competitive marketing.

The important new production of the Free World will come from high-grade deposits of Australia and Western Canada. Since consumption and inventory accumulation cannot absorb this new production, other Free World production—mainly in the US—must be displaced. A low market price will probably be the displacement mechanism.

A summary of the previously announced major projects in Australia and Canada are listed in Table 2. In addition, there are a number of smaller and lower grade deposits in both countries, some of which may begin production during the same period.

Table 2

NEW PRODUCTION CENTERS IN AUSTRALIA AND WESTERN CANADA WHICH MAY START UP IN THE 1980'S

Country/Project	Probable Production Level (Millions of Pounds U_3O_8/Year)	Estimated Project Life (Years)
Australia		
Ranger	6.6	40+
Koongarra	2.4	11+
Jabiluka	6.6	30+
Yeelirce	6.0	22
Olympic Dam	9.0[1]	50+
Canada[2]		
Key Lake	8.0+	20+
Midwest Lake	4.0	14

[1] Uranium produced as a co-product of copper.

[2] In addition, the Collins Bay mine will start up during this time period, but the ore will go through the existing Rabbit Lake production center.

Each of the deposits listed in Table 2 will likely be brought into production at costs below US $20 per pound (in constant 1981 dollars). It is readily apparent that the Australians and Canadians have the capability to assume cost leadership in the market as these new projects come into production.

The production of by-product uranium in South Africa will continue to supply an important segment of the market. Uranium is produced currently as a by-product from ten mines and as a co-product from five mines in South Africa. The current rate of production is about 18 million pounds U_3O_8 annually. South African producers have established their position in the uranium market and are in a favorable situation to compete with the Australians and Canadians for future sales.

The contraction of US production has already begun. As long-term delivery contracts are fulfilled, producers will cutback on production and eventually close mines and mills because operations will not be competitive in existing spot or long term markets. The contraction of production will continue into 1990 when US production levels will have decreased about 60 to 70 percent below 1980 production.

The world uranium market price will probably remain below the price required for profitable operations by most US producers for several years. Only a few US producers can compete in the present market price range of $23.50 per pound U_3O_8. The exception will be the case where the utility purchaser has a "buy US" bias.

Market Impact

A paradox is developing within the US producer/consumer industry. The producer industry is facing substantial curtailment of production during the period in which Nuexco projects US consumption requirements will increase to 40 million pounds by 1990.

The critical question is whether US utilities will purchase large quantities of non-domestic material to meet their future needs. Nuexco judges that over the next ten to 15 years, utility purchasing agents will gradually increase their willingness to purchase foreign uranium. Some utilities which previously intended to limit foreign supplies to between 25 and 35 percent of requirements now talk about increasing their limits to perhaps 50 percent of requirements. The transition will be slow and will develop as US utilities gain confidence in the reliability of non-domestic producers. The US utilities as an alternative can pay a substantial premium to maintain United States producers, thus creating a two-tier market.

There are US producers that suggest a second uranium embargo is needed to protect the US production industry. At the same time, there are non-US producers and potential producers expressing concern about the embargo possibility. Such an embargo would likely establish the two-tier market and force utilities to purchase higher price material. Nuexco does not anticipate an extension of the embargo. There is little economic justification for an embargo and there are potential political ramifications associated with such an act upon the major US trading partners, Australia and Canada.

US utilities will continue to search out US producers which can supply material at or near market price. These producers must seek ways to remain cost competitive. In-situ production, by-product production and discovery of shallow high-grade ore bodies are the principal routes to success. An improved social, financial and, perhaps most importantly, political environment, are essential elements to this end.

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"WHAT HAPPENED TO THE URANIUM BOOM?"

by M.J. Reaves

The title of my talk, "What happened to the Uranium Boom?" is old news. Certainly it is for this group. All of us that make our living in uranium know that the boom of the last half of the 1970's is over. US production has been exceeding consumption by more than two to one. Mines and mills are closing and yellowcake prices have been dropping for over 20 months. The gloomy outlook for the industry in the near term has been well documented by observers of various descriptions, your daily newspapers, and in the Nuexco Monthly Reports.

I'd like to attempt to describe the next upturn in the market (speculate, really) based upon the clues we are seeing now. In order to do that, I would first like to go over briefly some of the market factors that contributed to the recent price drop and resultant production cutbacks, and then hypothesize on the way these factors are changing and will change.

Market prices are greatly affected by buyer perceptions. This is particularly true with uranium, because of the long lead times associated with nuclear plant construction and also with conventional mine mill development.

Before the price rise, utility uranium buyers believed that:

1. US producers would have difficulty expanding to meet US demand.
2. Australian and Canadian production was essential to avoid shortages in the early 1980's.
3. Uranium prices would continue to rise as demand exceeded supply.
4. Enrichment capacity would become inadequate. It was thought necessary, therefore, to build enriched inventory in the early 1980's for use in the late 1980's. Artificially accelerated expansion of the uranium producer industry was necessary to accommodate anticipated enrichment demand.

Current perceptions are largely the opposite. These are the beliefs that were held most of this year and late last year as prices dropped:

1. US production is far in excess of domestic need. Contraction of the US production industry is necessary.
2. Canadian and Australian supply is optional and not essential. Producers in those countries are expanding mainly by displacing higher cost production and not because they fill a void.
3. Prices may be essentially stable for some time.
4. Enriched uranium is in excess supply.

1982 is shaping up to look like this:

1. Prices will have bottomed out. (That is not Nuexco's opinion necessarily, by the way, but it is my opinion.)
2. There will still be substantial utility inventories, but fewer spot sales.
3. Canadian and perhaps Australian sellers will have made substantial sales in the US and will be aggressively seeking more.
4. US production will have been dramatically curtailed. US utilities that wish to contract long term will have difficulty in finding domestic sellers. Concern will develop about the availability of US production capability. Virtually all long term contracts signed will be with non-US sellers.
5. An awareness will begin to develop among US buyers that we are approaching a period of dependence upon foreign uranium.

The history of the uranium market has been one of dramatic changes and overreaction to those changes. The rapid price rise of a few years ago generated excess US production capacity and the rapid price drop of the last two years will almost certainly result in too little capacity. It will soon be difficult for US buyers to buy domestic material except on the spot market. The question is, "will they care?"

The lack of demand, of course, is the underlying reason for the current poor health of the uranium industry. In 1972, 1973 and 1974 collectively, there were 105 nuclear reactors ordered in the US. That ordering rate was expected to continue and accelerate throughout this century. In 1975 through 1980 there were 56 more reactors cancelled than ordered. The net growth of our only customer since 1974 has been a negative 56. To put this in perspective, if these 56 reactors were operating now it would more than double present US uranium consumption.

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Underlying lack of demand is something that is simply not going to change in this decade. Time is going to be required. New reactors, if ordered tomorrow, would not generate new uranium demand until after 1990. Even so, US annual consumption of uranium will rise from the 1980 level of 18 million pounds to about 40 million pounds by 1990. World annual consumption also about doubles in the period from 40 million pounds now to over 80 million pounds in 1990.

Ultimately there will not be another uranium boom without a substantial upturn in the fortunes of nuclear power generally. In today's dollars, we cannot expect to see $40 uranium again in this decade, and maybe ever.

A price recovery in the uranium market in this decade will not result from an inherent lack of uranium worldwide, but may result from lack of US production. I believe that there will be a price recovery to some degree because prices have now dropped below the point that sufficient production capacity will not be available in the US to support the minimum quantity of domestic purchases necessary to accommodate the "buy US" bias of US utilities. The minimum "buy US" bias is that quantity of uranium that the US industry will insist it buy from US sources, somewhat irrespective of price. There is a quantity that the US industry will buy of US origin, even if it has to pay a $5.00 or $10.00 per pound premium for it. This quantity, or percentage, varies greatly among US buyers, of course, but we have attempted to estimate the aggregate total.

The origin for this bias toward domestic supply comes from several sources. For example, as a US Government entity, Tennessee Valley Authority (TVA) is probably not going to buy 100 percent foreign uranium. I cannot imagine a set of circumstances that would preclude TVA from buying some portion from domestic sources, unless there was none available at any price.

Utilities with one reactor are more likely to insist upon a US source, because they are not in a position to diversify their supply and want the most reliable supply sources available to them. We know utilities that simply will not entertain the thought of buying non-US uranium. In addition, numerous long term contracts are already in place with US buyers and US sellers.

A rule of thumb that is oftentimes quoted is that US utilities are willing to buy about one-third of their uranium from foreign sources. If you take a survey, this is what they would probably tell you. The real question is, given a substantial price penalty, would they really buy any domestic?

We believe that toward the end of the decade, more than half of the US supply will come from non-US sources. Canada, Australia and Africa will be dominant, with Canada the favorite. If the utility industry does limit itself to one-third foreign purchases, the story would be quite different and prices would have to be higher. A one-third limit is not a reasonable expectation, however, because of the likely price differential between foreign and domestic material.

In order to quantify the aggregate "buy US" bias, we looked at the uncommitted requirements of each utility and guessed how much domestic material each would insist on buying. The guess was based upon our knowledge of each utility and their previous foreign buying practices. In each case, when in doubt, we tried to guess low. On the aggregate, we concluded that the US utility industry will buy a *minimum* of 15 million pounds more of domestic material from now through 1985, and 70 million pounds more from now through 1990 than they already have either in inventory or under contract. These conclusions were intended to be conservative. At present prices, the way the US production industry seems to be shaping up for this decade, that level of domestic buying cannot be supported without a price rise. We simply have to use material in the over-$25 per pound cost category to support the minimum "buy US" bias as it is currently assessed.

It is important to remember that this price firming will be somewhat artificial and it will take place in a rather depressed worldwide uranium market. US production will have cut back significantly from 1980 levels, barring an embargo. It would not be reasonable in such a market to expect any significant new conventional mine mill development in the US because of the high cost of new facility investment, long lead times involved, and the fragile nature of the market. The situation is made to order for the in-situ producer that can initiate production in a short time, with comparatively low capital expenditures, and is on the low end of the production cost spectrum.

If the scenario develops as I am suggesting it might, a two-tiered pricing structure would likely develop, with some US buyers willing to pay a premium for US material over non-US material.

One example of such a two-tiered market existed during the last 1960's and early 1970's with US material being sold at about a dollar per pound premium over non-US material. This two-tiered market was due to the existence of the US embargo.

A second example is the premium that stringless uranium commanded a couple of years ago. This premium was paid for material the origins of which allowed reprocessing. Only buyers that wanted to reprocess were willing to pay the premium of about 50¢ to $1.00 per pound. This second example more closely parallels the situation I'm describing with premiums being paid only by certain US buyers for domestic supply. I would not expect two-tiered pricing to develop prior to mid-decade. The still existing overproduction capacity, together with the large domestic inventory in place, will preclude its happening.

All of us in contact with utilities have heard repeatedly the proposition that certain Public Utility Commissions will not authorize utilities to pay higher than "market price" for uranium. Perhaps some of them won't, but in a two-tier market it becomes increasingly difficult to define the term "market price." In any case, given the choice of paying a premium, however defined, for domestic material or buying 100 percent foreign origin material, many utilities will likely opt to pay a premium.

The idea of an import embargo is being encouraged by some people as a curb on the expected influx of foreign uranium. Although we do expect some Congressional consideration of an embargo, we don't expect an embargo. There are several reasons. The best one is that an embargo won't solve the problem. An embargo will not generate new demand. Even if there were a total embargo in effect now, we'd still have twice as much production in the US as we need and that situation has to change. Of course, it is changing and the transition is painful.

In conclusion, I'd like to say that the "buy US" bias of domestic utilities is real, and the US industry will not be entirely displaced by foreign sellers although by the end of the decade there will be a significant displacement. There are going to be some bright spots. I firmly believe that the in-situ producer in the US is in the best position to take advantage of the market opportunities that will present themselves over the next ten years.

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